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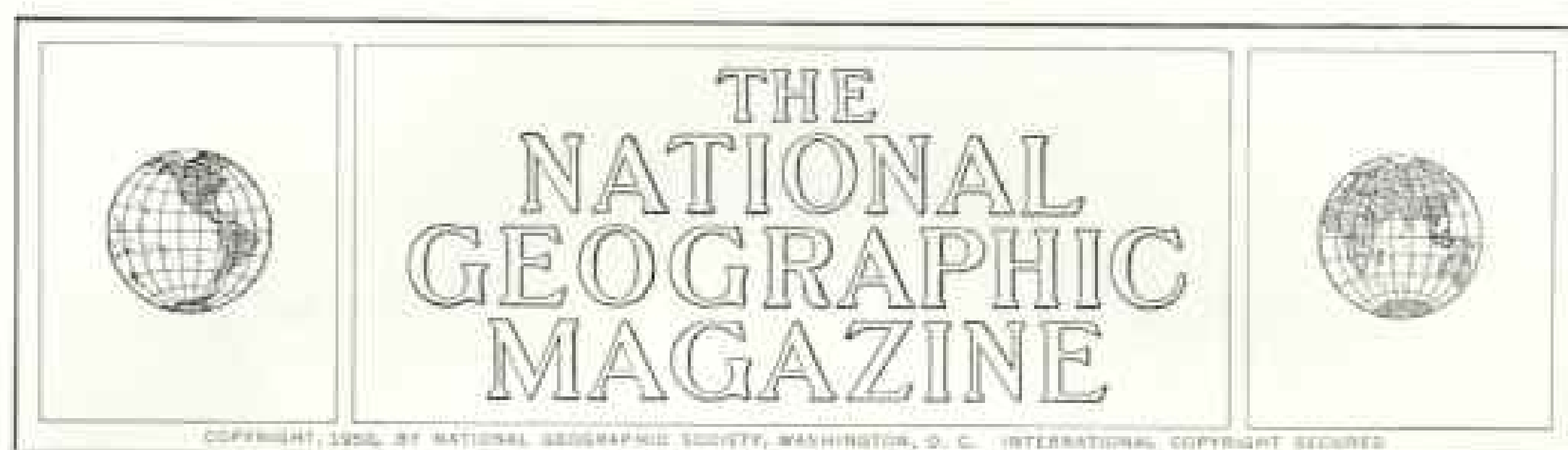
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Speaking of Spain

BY LUIS MARDEN

With Illustrations from Photographs by the Author

ALL SPANIARDS," the saying goes, "have in them a little of Quixote, something of the poet, and a good deal of the bullfighter."

But first and last, the Spaniard is an individualist. The philosopher Miguel de Unamuno wrote of his countrymen: "It is difficult to govern a nation of 22 million kings"—and now there are 28 million of them.

Through more than a decade of travel through the countries of Spanish America for the NATIONAL GEOGRAPHIC MAGAZINE, I came to know the offspring pretty intimately, but always I was curious about the mother country. When finally I went there, I was impressed by Spain's people even more than by the rugged beauty of the mountainous peninsula.

My introduction to the country was typical. I had driven from Paris through southern France to the international bridge at Hendaye. French officials told me that the day was a Spanish holiday, but they let me walk across the bridge into Irún.

On the Spanish side, a Civil Guard in a shiny patent-leather three-cornered hat and yellow Sam Browne belt took me to the customs inspector, who told me he had no permits for me to enter with my photographic equipment and car of French registry. The representative of the Spanish State Tourist Department, who had my papers, was in San Sebastián with his family.

I said I would wait in France until the next day, but the customs inspector would not hear of it.

"If you don't mind," he said, "wait a little longer. If Don Cecilio does not return with

the papers, come over with your car anyway. I think you would like to stay in San Sebastián, which is only 11 miles away; you will be more comfortable there. We will permit you to drive to San Sebastián to spend the night, if you promise to return in the morning to go through customs."

The assumption that everyone will respect a gentleman's agreement, and that a man's word is inviolable, is typically Spanish.

Shortly after our talk, Don Cecilio arrived at the bridge. Everything was put through in a few minutes; then all of us—Don Cecilio, the customs inspector, a captain of the Civil Guard, and I—went to a small bar near the international bridge and with wine of Jerez drank a toast to my first night in Spain.

That night Don Cecilio drove with me to San Sebastián. This fashionable watering place faces a horseshoe-shaped bay, the Concha. Here the late King of Spain had a lavish summer palace, and people of fashion come in season to be seen and to bask in the sun.

Spain Averages 2,000 Feet Above Sea

Late one evening I started on the 300-mile drive over the mountains to Madrid.

Spain has nearly every kind of topography and climate—snow-capped mountains, bare hills, fertile green farmlands, austere steppes, and subtropical southern coast plains. But the feeling of height and the cold, sharp air of altitude predominate.

After Switzerland, Spain's tumbled terrain averages highest above sea level in Europe. The land has an average height of 2,000 feet, and nearly everywhere it rises directly from



Every Spaniard Loves Sea Food—and a Man with a Camera

Madrid's big central fish market near the Toledo Gate receives and distributes tons of sea products each morning. These turbot, highly esteemed on the table, often reach a weight of 30 to 40 pounds. Their smaller relative, the sole, is one of the world's finest food fishes. In America, where the edible sole does not occur, "sole" on a menu usually means another flatfish, the flounder.

the sea, rather than from a lofty central plateau, as in Switzerland.

The highroad of France that runs from the frontier to Madrid passes through the old cathedral city of Burgos. The night I was there a half-moon made the fretted stone bulk, its boss-studded spires flecked with black patches in the white light, loom more like a fortress than a church.

According to academicians, people of Burgos and Valladolid speak the purest Castilian. I found it necessary to reorient my Spanish in Spain. For example, the second person plural of verbs—the *vosotros* form—has disappeared from the common speech of Spanish America. I had to learn it all over again, and for some time felt self-conscious in the use of it. In Spanish-speaking America it is used only in

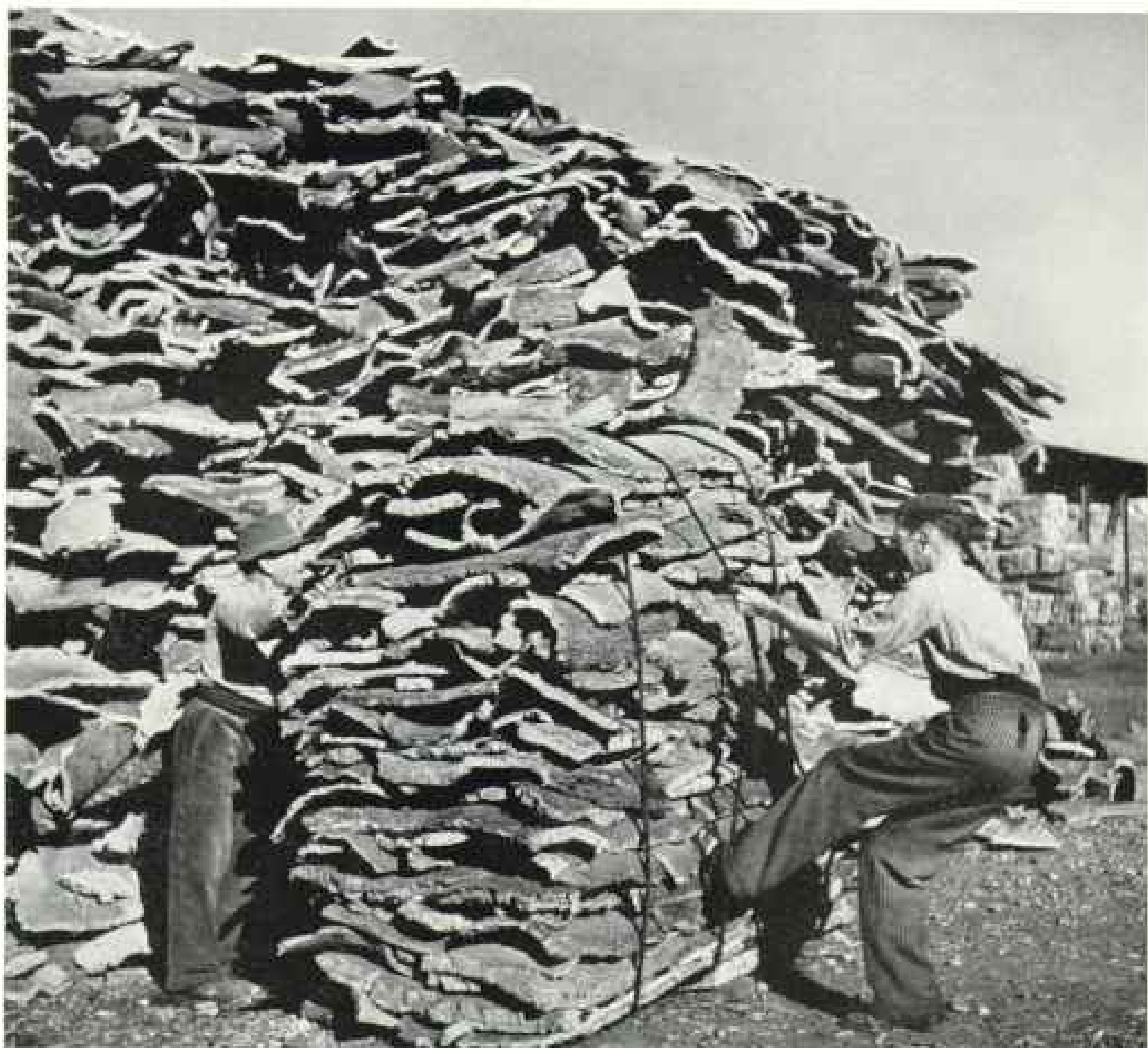
sermons, Presidential proclamations and speeches, and the like.

Beyond Burgos the road ran among rolling hills, through villages of barred and shuttered stone houses. When I heard music and saw figures moving on a playing field in one village, I stopped to look. Villagers were dancing in pairs to the music of a clarinet, trumpet, and accordion.

When I asked one of the men what the occasion was, he looked at me in astonishment. As if one needed some special reason to dance!

Madrid Nearly in Exact Center

Madrid lies almost at the exact geographic center of the country. It stands at the northern end of the somber plateau of New Castile. The surrounding wind-swept and treeless plain,



Bulky Cork Bark Is Light Because More than Half of It Is Air

Sevilla workmen bale the spongy outer bark of the cork oak, *Quercus suber*. Such oaks grow wild throughout Spain, and are stripped every nine to ten years during the summer months. Processors boil and scrape cork, then divide it into three to five grades, according to thickness and quality. Best grades make, among other things, bottle stoppers and fishing-rod handles.

and an altitude of 2,150 feet, highest of all European capitals, give this city of nearly a million and a half a harsh climate. Winters are cold and summers burningly hot.

I drove into Madrid in the dark hours of early morning, too tired to notice much of the sleeping city; but when I left my hotel later that day, I found myself in the center of a handsome "monumental city," with many public monuments and fountains, broad avenues, and elegantly ornate architecture. Even banks and insurance company buildings are topped by symbolic statuary and heroic-size quadrigae in the grand manner.

Under arching jets of water at the center of a circular plaza the goddess Cybele sits in a chariot drawn by lions (page 444). Close by, with its embrasured façade facing the Paseo

del Prado boulevard, stands the Prado Museum.

As I wandered through the galleries, my head swam with the fabulous profusion of Velázquezes, El Grecos, Goyas, Murillos, Tintians. Pictures that I had seen reproduced only in art books and in prints were here in their original beauty.

From the Cybele fountain the Calle de Alcalá, Madrid's principal street, runs straight to the square of the Puerta del Sol (page 450). Just beyond the Cybele, the Gran Vía, main shopping and theater thoroughfare, branches off from Alcalá, runs uphill to the Plaza del Callao, then tilts downward again; so that from this end on a clear day one can see in the distance the mountains of the Sierra de Guadarrama.



Drawn by Theodor P. Thompson and Irvin E. Alliman

Like a Stretched Bull's Hide Is the Outline of Mountainous Spain, Second Highest Country of Europe

Spain's average of 2,000 feet above sea level is exceeded only by Switzerland. Occupying six-sevenths of the pentagonal Iberian Peninsula, the country has such varied topography that it has been called "Land of the Unexpected." Abundant rains fall in the northern maritime Provinces, but most of Spain has a dry, sunny climate, with extremes of cold and heat, expressed in the old Spanish proverb, "Nine months of winter and three months of hell."

In winter, icy winds from the snow-covered Sierra blow across the open plain to whirl down the length of the Gran Via. But in fine summer weather, swank cafés place tables on the sidewalk. Crowds jam these "terraces" at the apéritif hour before lunch or dinner.*

Cafés Are Streetside Offices, Clubs

Shops and offices close at 1 p.m. in Madrid, to reopen at 4. People begin to drift to the cafés about 1:30, and by 2 o'clock tables are at a premium.

Close to being all things to all men, the cafés combine club, office, forum, theater, and trysting place. Most employ a Buttons, a boy in bellhop uniform who runs errands for

clients. He will buy a newspaper, get shoelaces, bring writing paper and pen and ink, make a telephone call, or climb five flights of stairs to deliver a message to a phoneless friend.

Habitual customers may sit for hours over one or two cups of coffee; no one, except shoeshine boys and sellers of lottery tickets and cigarettes, will disturb them.

There are 1,500 taverns and nearly a thousand cafés and bars in Madrid alone. Taverns form the humblest category: they are small, friendly places where customers stand at the

* See "Madrid Out-of-Doors," by Harriet Chalmers Adams, NATIONAL GEOGRAPHIC MAGAZINE, August, 1931.

counter to drink white wine or beer.

More pretentious are the bars, with tables and a more diverse selection of *tapas* (snacks), such as cold cuts, shrimp, clams, oysters, crabs, lobsters, goose barnacles, and fried squid.

Most elegant of the three, the cafés proper often are sumptuously furnished, with crystal chandeliers and period furniture. Some strive for originality; in one, live songbirds fly about and perch on branches behind the bar.

In Spain the *apéritif* means food as well as drink. People sip sherry, manzanilla, or beer while eating appetizers of all kinds.

Spaniards love sea food before meals. To see shellfish in its variety and abundance, one must go to one of the few places in Madrid that serve draught beer. Here the discarded shucks of boiled shrimp rise in ankle-deep pink drifts on the floor. Spaniards eat shrimp the year round and must consume hundreds of thousands of pounds annually.

As an old shellfish fan, I thought I was familiar with most of these sea products, but here I found some new ones. An enormous crab I saw weighed more than five pounds (page 440); the girl who sold them said they sometimes reach double that weight, and I could see why Galicians who catch these call them "oxen of the sea."

With a friend whom I had first met on the ship going from New York to Cherbourg, I went one night to the street called Echegaray. At 9 o'clock, cocktail hour in a country that dines from 10:30 to 11, narrow Echegaray Street is thronged with people. Almost every other door opens into a bar or tavern, many of which decorate their walls with brilliant



Madridños Must Be Home by 11 or Be Locked Out

At that hour night watchmen rap on Madrid doorjambs, warning householders they are about to lock up. Late-comers clap hands to summon the guard, who carries the apartment key in his leather vest. Some residents have their own passkeys (page 422).

bullfight posters or with regional scenes in colored tile.

Natives of Madrid Called "Cats"

Madridños (natives of Madrid for some reason are also called *gatos*, "cats") progress slowly down Echegaray, stopping at every—well, nearly every—bar for a small glass of white wine. Most wineshops throw in a snack with the drink. This may be a fried shrimp, a bit of mountain ham, a miniature meat ball, or a hot sausage on a square of bread.

In one tavern we sat on high stools at upended wine casks for tables, watching the stream of customers. A man overheard us talking and said:



Like a City of the King Arthur Legends, Ávila's Battlements Loom Through Early-morning Mist

Ávila carefully preserves one of the world's finest medieval walled cities (page 432). Stories return each year to ever-growing untidy nests on its bellies and towers. The city stands on the bleak Castilian plain between two mountain ranges, from which wolves descend to raid sheep flocks grazing outside the walls.



As Regular as Sunday's Noon Mass in Córdoba Is the 1 o'Clock Shine Outside Church

Gabardine topcoats are standard in Spain. Many men throw them round the shoulders, cloak fashion, like two of these Córdobans. Some of these shine boys wear rope-soled sandals. Inflation has driven up the price of the shine, but it sells for less than five cents.

"What! An American come to write about Spain? Stupendous! Have a drink."

"Stupendous" currently describes everything in Madrid; it has become the favorite adjective of Spain.

White-aproned men behind the bar bustled about with sticks of white chalk thrust over one ear. When they set down the small glasses of white wine, they wrote the amount of pesetas on the counter before each customer. They did this for each round, then totted up the amount to be paid before wiping the bar clean with a damp rag.

Behind the bar stood a small slotted barrel, the *bote*. A client left a few *céntimos* for a tip. Before dropping them into the barrel, the barman cried, "Twenty for the bote!" and all his colleagues shouted in drawn-out unison, "Gra-c-i-a-s!"

Columbus an Ensign in Spain's Navy

Titles of nobility are still common in Spain; one meets counts regularly, marquesses occasionally, and once in a while a duke.

Names connected with the conquest and discovery of America are still alive here. I met the Viscountess of Ilúcan, a black-haired lady named Alicia Moctezuma, who is a direct descendant of the last emperor of Aztec Mexico. She closely resembles portraits of the monarch, even to a mole on the cheek.

The present-day Christopher Columbus, Duke of Veragua and Admiral of Castile, is a young ensign in the Spanish Navy.

"If you meet him, don't say I told you," said a friend; "but when he took his entrance examinations for the Naval Academy, he failed in only one subject—navigation."

Spaniards take their scholastic careers seriously; courses at city schools demand it. One man complained to me that his son had to study calculus at the age of 12.

When I was in Madrid, the streets, like volcanic earth, were in a constant state of unrest. Workmen tore up the cobblestone paving of whole blocks and squares at a time.

There is the story of the foreign visitor who, when asked how he liked the capital, replied, "It should be beautiful—when they finish it."

Most Madriderers live in flats in multistoried apartment houses. On the street level, big double doors of wood or of iron grillwork open into an entryway where the concierge has his rooms.

The old custom of the night watch persists in Madrid. At about 11 every night, the watchman, who usually wears a brass-bound visored cap and carries a truncheon, walks along his block, rapping with his night

stick on doorjambs as he goes. This warns the householders that locking-up time approaches (page 419).

When I walked for the first time on silent Madrid streets after midnight, I was startled to hear a smacking sound. The reports sounded like pistol shots in the still night air.

Rounding the corner, I saw a man impatiently clapping his palms together. Someone called "Coming!" and the night watchman, muffled to the throat against the chill, came running up. From a many-pocketed leather vest he selected one of a dozen big keys and unlocked the door.

Night owls usually tip the watchman who lets them in, even though each tenant contributes a monthly sum toward the man's salary. A few forehanded people carry their own passkeys, unless they live in an old building, in which case the huge iron keys are too bulky.

One must also summon the watchman to be let *out* of the building. When with a dozen people I left a party late one night, we had to thrust our hands through the grillwork of the locked front door to clap. Nearly a quarter of an hour passed before the watchman, who had taken refuge from the cold in a tavern near by, came out and heard us.

Traditionally, the night watchmen of Madrid come from Galicia. Mostly they are discreet, silent men who, though they see everything, see nothing.

Cloaks Are Coming Back

As the nights grew colder in Madrid, I began to see men wearing the *capa*, the typical cloak of Spain. Mostly older men wear them now, but people told me that more cloaks have appeared in Madrid in the last year or two.

One must know how to "carry the cloak," the Spaniards say, to wear it with grace and elegance. The best ones come from Seseña's shop, in Madrid. Made of fine woolen Béjar cloth, most modern cloaks are short, coming to slightly below the knees. Usually they are midnight blue or black, though occasionally one sees a high-collared "Goya" in brown or maroon.

When laid out flat, the *capa* forms a full circle. It is cut full so that the wearer may throw one edge, lined with velvet or fur, round his neck in cold weather.

Thus enveloped, a man is snugly warm, but as tightly confined as if rolled in a rug. I wonder how Spaniards of an earlier age drew their swords in a hurry.

I wanted to find out something about bulls and bullfighting, so I went to the suburb of



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Enrichments by Luis Muriel

In La Mancha, Where Don Quixote Tilted at "Giants," Huge Mills Still Spin

Cervantes's mad knight imagined the whirling vanes were menacing arms. When he charged, the sails toppled him from his horse; hence the phrase for foolish enterprises, "tilting at windmills."



Tandem Riders, Carnations, and Round Felt Are Sure Signs that Fair Is On in Sevilla

This is what Spain means to romanticists; bright skies, dancing, guitars, and gaiety. Sevilla's round of excitement follows the solemn rites of Holy Week. Andalusia's carnations have brilliance but little scent.

Woman's Gay Millinery Is Man's Old Hat

One hundred years ago men wore this same style. Called a *calañés*, it now adorns riders at Fair and festival in Sevilla. Most equestriennes also tie on a kerchief and ride side-saddle.

Andalusia's wide plains nurture Spain's fighting bulls. Where a railway line bisects a ranch of "brave" cattle, the ferocious bulls sometimes charge passing locomotives.

Breeders say bulls develop strong muscles if they must walk a long distance to their drinking place—usually the River Guadalquivir.

Even the fighting spirit of the breeding cows is tested with lance and cape in a closed ring. Young bulls, which must not be injured or fought, are toppled by a horseman with a blunt lance on the open plain. The breeder carefully notes reactions in a studbook and sells cowardly animals for meat.



This Bailén Donkey Wears a Practical Ornament

The elaborate woolen hackamore and muzzle prevent the young donkey from delaying the caravan by trying to suckle on the road.

To the Spanish countryman the donkey is pet, friend, and willing worker. When a thief took Sancho Panza's ass in Sierra Morena, near where this picture was made, Sancho wept, crying: "O . . . my children's pet . . . solace of my cares . . . half supporter of my person!"

This muleteer, photographed on the road to Jaén, wears the *boina*, or beret. Originally from the Basque country of Spain, the *boina* now has nearly supplanted the visored cap formerly worn in Castile and Andalusia.

At Bailén in 1808, Spaniards overwhelmingly defeated Napoleonic troops.

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Kodachromes by Luis Marden



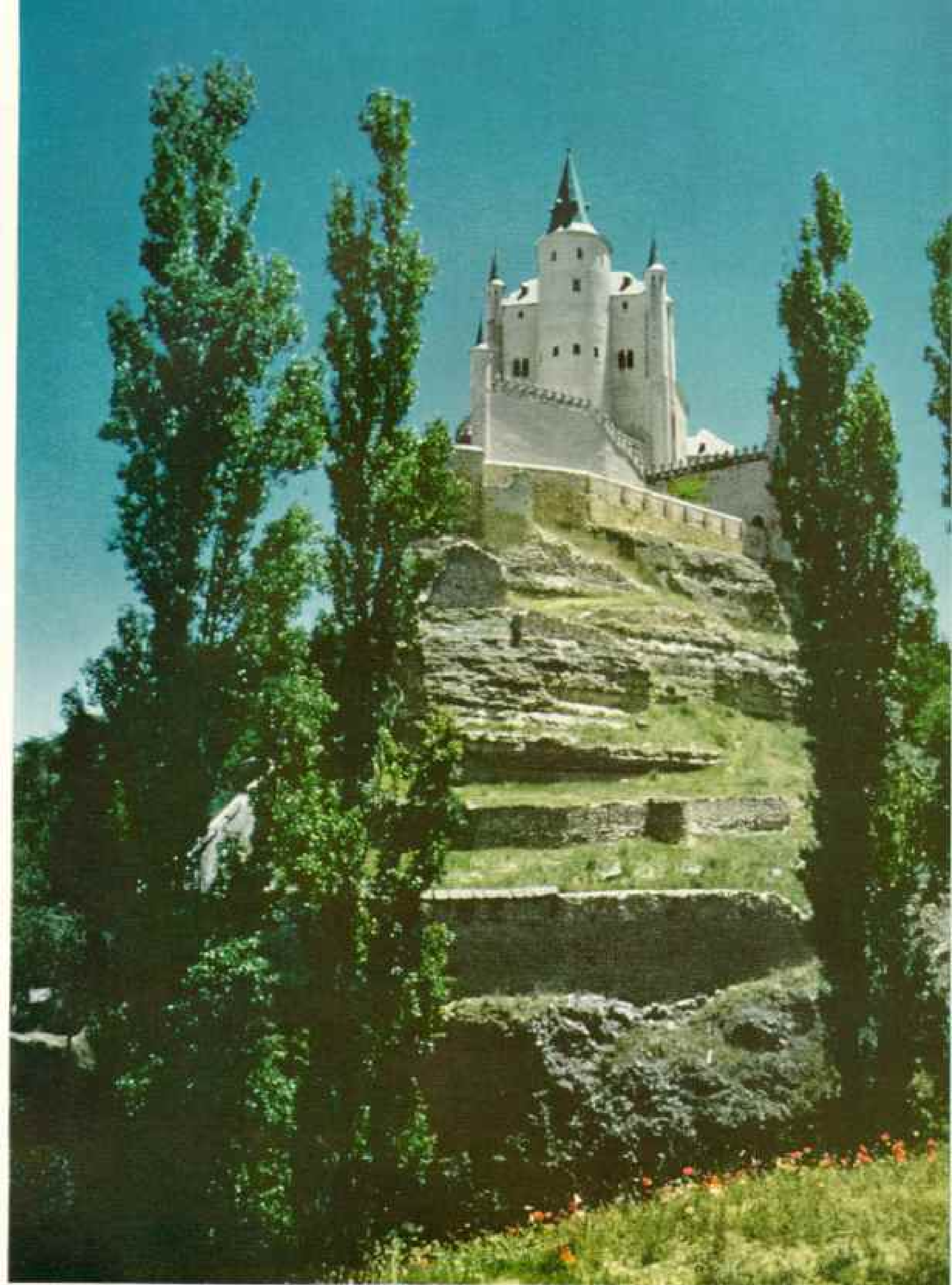
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Illustration by Lilla Marden

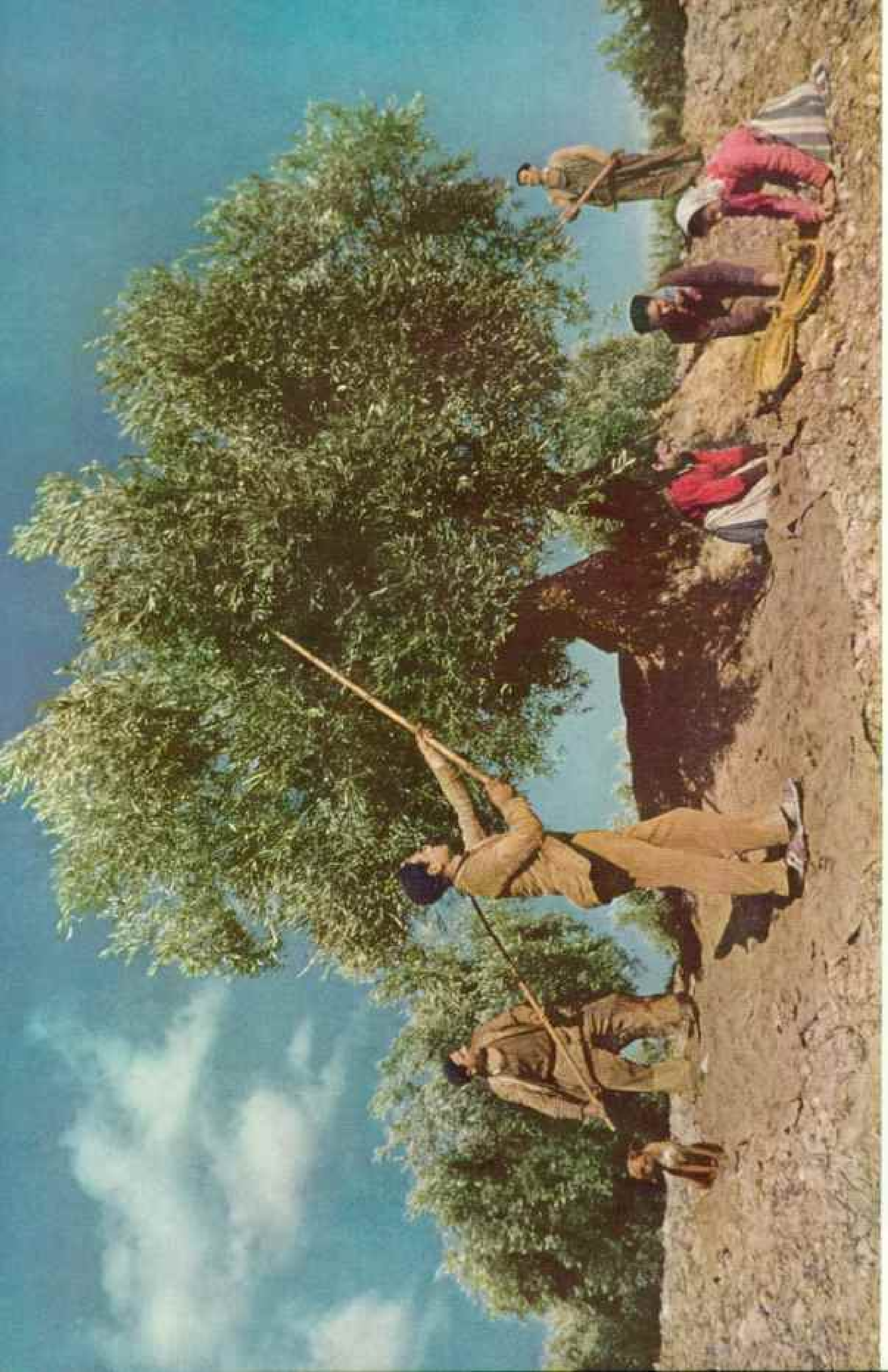
On the Golden Sands of Sevilla's Ring, a Bull Prepares to Charge His Enemy

Andalusia's principal city is the cradle of one of Spain's two principal schools of bullfighting. Another, of more sober style, originated in Ronda. Novices dream of appearing in Sevilla during the Fair—bullfighting's "World Series."



Segovia's Soaring Alcázar Fulfills Every Man's Vision of a Castle in Spain

Alfonso VI began the citadel in the 11th century. It has undergone enlargements, fires, and restorations until today, with its round, pointed turrets, it resembles a French château.



Andalusia's Olives and Olive Oil Travel Round the World

Nearly half of the world's olive oil comes from Spain. On the opposite page, men thresh the branches while women gather the fallen fruit.

Many of Spain's olive trees are one hundred years old; some still produce after several centuries.

Most young trees are pruned to grow up into two "feet," or trunks. After the harvest, workers crop twigs and foliage, then feed the leaves to livestock.

Left: Black ripe olives are ready to be ground and pressed for oil.

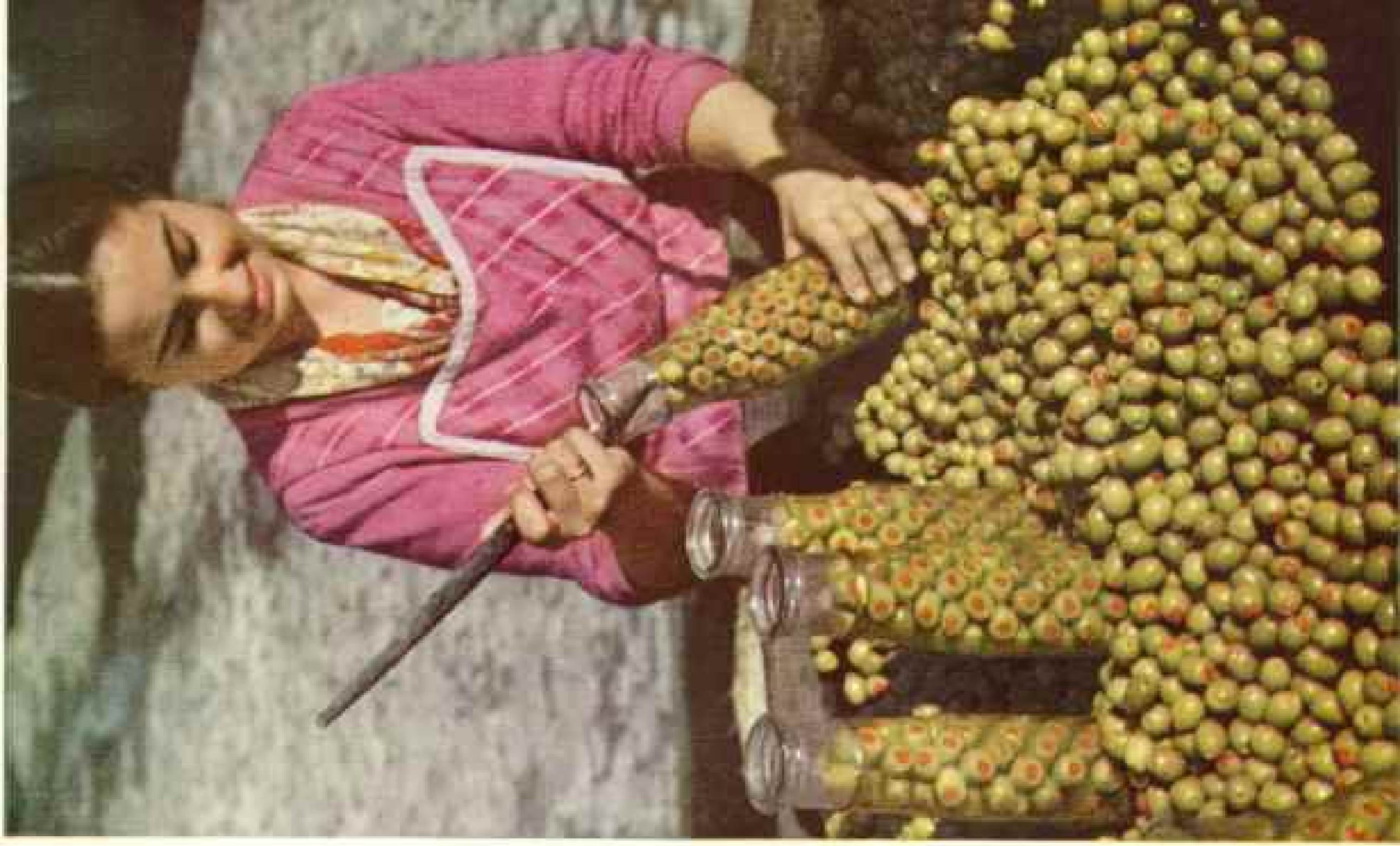
Green or black eating olives usually are picked by hand to avoid bruising. Freshly picked olives are bitter; they are made palatable by soaking in brine.

Stuffing with pimientos is done in countries of destination, but Spain now packs some stuffed olives for domestic use. At right, a worker manipulates the fruit with a stick, so that each red button faces outward in the jar.

A hand-operated device like a drill press punches pits from olives. When the fruit is stuffed with anchovies, the circular plug clinging to the pits is replaced, so the olive looks whole.

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Kochelmann for Lela Marden





A Gypsy Girl and the Alhambra Embody the Beauty and Romance of Spain

England's Duke of Wellington once declined the Granada palace as a gift, considering it impractical. Spain today would as soon give up the national treasury as the priceless Alhambra.

Fuencarral to talk with José Roger, a retired matador with the ring name of "Valencia," who kept a bullfighting school.

In a small bullring on the grounds of Valencia's house, I watched serious-faced young men training for the dangerous profession. One of their number acted as the bull. With a pair of bull's horns held in the hands he charged the capes of his fellow students.

Pepe, the master, explained the difference between the magenta silk cape, which is held in both hands, and the scarlet serge *muleta*, usually used with only one hand in the final stage of the bullfight.

Pepe showed me how to hold the cape, with the elbows held away from the body and the wrists supple and natural, "dominating" the bull and taking him past the body with the cape, then twisting in the opposite direction to receive the bull's next charge (pages 426, 435).

Bullfighter Turns Fisherman

All this and more Pepe explained, until my friend Julio told him I was a trout fisherman. Then the killer of bulls became a killer of trout.

"Man!" Pepe said excitedly. "Lacking masters, I have had to teach myself to cast the fly. With an old rod and a piece of cord, I practice in this very ring. Tell me, do you fish the dry fly?"

From then on I could learn nothing more about bullfighting. When Pepe showed me his exquisitely embroidered "suits of lights," he said:

"See, here is where I have pulled out the gold and silver threads to make trout flies."

With regard to trout fishing, "Practically all the rivers in Spain north of Madrid contain trout," Pepe told me. "Madrid's water supply comes from the Lozoya, a good trout stream not far from here. The other day workmen opened a water main downtown and took out a fat trout about a foot and a half long."

For some reason, I had always thought of Spain mainly as a warm southern country. Actually, Madrid lies near the latitude of New York, and the northern coast of Spain almost coincides with the Maine-Canada boundary. This helps explain why trout and salmon rivers abound in Spain.

"We allow no netting of salmon or trout in this country," said Max R. Borrell, director of sports for the Spanish State Tourist Department. "On the other hand, we have about 5,000 rod-and-line professional fishermen on our rivers, who make their living by catching trout and salmon for market. Frequently the

professionals catch 40 to 50 trout a day with the fly. We have a closed season, but no bag limits.

"Thousands of salmon are taken each year by sport and professional anglers. On the opening day of the 1949 season, a 35-pound salmon was caught in the Nansa River."

Salmon an Expensive Dish

Salmon in Spain, which are the Atlantic species (*Salmo salar*), identical with salmon of Scotland or Canada, may bring two to three dollars a pound in the Madrid market early in the season. Some anglers who come to Spain defray part of their expenses by selling their catch. Mr. Borrell added that broadbill swordfish and giant bluefin tuna abound in the sea off Tangier and Tarifa.

I asked him about shooting in Spain.

"We have nine species that we list as big game—bear, wolf, ibex, chamois, red deer, fallow deer, roe deer, wild boar, and lynx.

"As to birds, it is not uncommon to shoot a hundred ducks or graylag geese in one day. One of our best shots, the Count of Teba, shot in one 5-month season 4,072 partridges."

In season, partridge, trout, and salmon commonly appear on the menu of Madrid restaurants. I asked how, in the face of these enormous bags, it was possible to maintain such an abundance of game.

"Spain is relatively little industrialized," said Mr. Borrell, "and therefore does not have the widespread river pollution of a heavy manufacturing country. We still have immense tracts of wild and desolate country. And then there are few hunters and fishermen, compared with the total population."

In a booklet written by the English wildlife artist W. H. Riddell, I read of the extraordinary flights of waterfowl in the Marismas, the vast expanse of marshland at the mouth of the Guadalquivir River in southern Spain.

Riddell records that he saw a mass of ducks at rest in open water, ten ranks deep and nearly three miles long. He estimated that the flock contained thirty to forty thousand widgeon. These, with teal, mallard, and pintail, are the species most commonly seen in Spain.

Through the courtesy of Don Luis A. Bolin, Director General of the Tourist Department, I was invited to visit a fishing and shooting preserve in the Sierra de Gredos, a mountain range near Ávila, where lives a rare wild goat, the Spanish ibex (*Capra pyrenaica*).

The state protects the ibex, which live high up in the snows of the Sierra. No hunter may go out without a keeper and trackers, who make sure he shoots only old males.



Cut a Covered Wagon in Half: You Have a Murcia Taxi

With their red paint and brass trim, Murcia's carriages add color to its streets. The eastern Spanish city is a center for fishing-tackle manufacture. Twenty-two firms make rods, flies, and especially silkworm gut. For more than a century Murcia has specialized in this filament, used in fishing and surgery (page 438).

The Sierra de Gredos lies west of Madrid, and we drove over the mountains to Ávila to approach it on its northern slope.

Ávila is a nearly perfect example of the medieval walled city. Its amazingly well-preserved walls, 40 feet high and 10 feet thick, were built in the 12th century of materials taken from Roman remains. As we drove across rolling country, Ávila's machicolated walls appeared in notched silhouette against the clear Castilian sky (page 420).

We entered the city through a lancet-shaped gate from which yellow sunlight poured as through a funnel.

On towers and battlements storks perched on untidy nests of piled sticks, and ever and

again a parent bird glided down on black and white pinions, with a lizard or snake dangling from its red beak.

After feeding the young, the storks tilted their heads back and clicked their mandibles together, producing a sound somewhat like the drumming of a woodpecker.

No More Kisses

Under the arched gallery of the rectangular main square we walked to "La Taurina." Refreshing our dusty throats with red wine of the region, we asked the proprietor what he had for snacks. He pointed to a row of framed signs on the wall, each with a color cartoon illustrating the snack it described. I saw "Shrimp in a Top-coat," "Sausage in a Bun," and then I saw a brightly colored picture of a pretty girl, with the legend *Besos de Dama*—"Lady's Kisses."

"Bring me a double ration of those," I said.

"You will comprehend, señor," said the barman, "that those are so tender they do not last throughout the

day, and already it is late afternoon."

The proprietor told us that townspeople were organizing for a wolf hunt. In the previous few days wolves had carried off 19 sheep. In many parts of Spain wolves are still common enough to be a real menace to livestock.

Beyond Ávila the road leaves the plain to climb through a mountain pass to the Government's Gredos guesthouse of stone. We had arrived in moonless darkness; so when I opened the shutters of my window the next morning, the view took me by surprise.

Before the hotel the ground dropped to the valley of the Tormes River, invisible in groves of pines. Scrubby broom covered the nearer slopes. Beyond, the snow-covered Sierra glit-

tered against the dark sky. As I watched, the glow of the rising sun suffused the snow fields with dull rose, then brightened to orange and through increasingly brilliant yellow, until the snows at last burst forth in a white light so dazzling it hurt the eyes (page 451).

After breakfast we drove down to the river through stone-fenced villages and hamlets, centers of sheepherding and small farms. Here the Tormes, a wide, clear mountain stream, flows between bare, rocky banks.

As the sun rose and warmed the sharp air, we saw many brown trout in the river, suspended as if in green glass, dark-olive shadows motionless except for a gently undulating tail.

It was early in the season for dry flies, and few came even to our tailless and wingless Spanish wet flies, which were based on models originated near León in the 18th century.

Our host, Señor Pérez, sighed and said:

"It is always the same; our trout are not very gallant with foreigners. They want to see a Spanish passport before they give themselves up."

Thirty feet above us in one pool, I saw a good trout hanging over a bed of golden gravel. Each time my small English dry fly floated over him, he fanned his fins a bit faster and shifted slightly. Finally, as the fly floated over his nose for the fifth time, he slowly tilted upward and drifted downstream with it, looking it over carefully. Just as the fly almost reached our feet, he opened his mouth and gently sucked it in.

I gave him a second to swim away, then struck sharply and came up solidly against a pound and a half of lively trout. When the



River Guard Smiles at a Trout, but Carries a Gun for Poachers

The head keeper of the Tormes River preserve in the Sierra de Gredos admires a brown trout taken by the author. On his hat he wears a cockade with the national colors, red and yellow. Spain licenses, besides sportsmen, professional rod-and-line fishermen who catch trout and salmon for market.

gillie netted him a few minutes later, he dispatched it by biting it on the side of the head. A male in perfect condition, the trout's vermillion spots glowed against the browns and butter yellow of his sides.

Central Heating, Spanish Style

It grew cold that night in the mountains, and in the guesthouse I learned to use the *camilla*, a round table with a charcoal brazier under it. A long woolen tablecloth hangs to the floor, with slits that enable sitters to place their legs and even their hands inside.

From time to time one takes a spatula and stirs the glowing charcoal, a finely ground fuel made of wood and carbonized olive pits. It

is a cozy way to sit on a cold night, particularly if one has an interesting partner to talk to.

One day I drove south from Madrid along the highroad that runs through La Mancha to Andalusia. Nine miles south of the capital, to the left of the road, a monument atop the Hill of the Angels marks the geographical center of the Iberian Peninsula.

This emphasized again the fact that Madrid is the navel of Spain. The town's central location probably helped influence Philip II in his decision to establish the capital there in 1561.

At Aranjuez, the bottle-green Tagus or Tajo, the river that empties into the sea at Lisbon (Lisboa), flows past the old Royal Palace that was originally built for Philip II in the same year he moved his capital to Madrid. Restaurants on the riverbank serve the famous asparagus and strawberries of the region, and rowboats and sight-seeing launches furrow the opaque green waters.

The Andalusia highroad climbs in sharp turns out of the green oasis of the Tagus Valley, into arid steppes again, and through La Guardia, a village formed almost entirely of cave dwellings. Rows of whitened doorways look out of sliced-off hillsides, and conical chimneys rise apparently out of solid ground, breathing spirals of smoke into the blue sky (page 448).

The Land of Don Quixote

Soon the road straightens and levels, to run in stretches straight as a map maker's rule through the level plains of La Mancha, a region that embraces parts of several Provinces. La Mancha—what images that name evokes! For here rode Don Quixote and his squire Sancho Panza.

The great classic of Spanish literature—"the best novel in the world," said Macaulay—has always been my favorite book. It is the most Spanish and one of the most universal of books.

Since the publication of the first part in 1605, the masterwork of Miguel de Cervantes Saavedra has gone through more than 2,000 editions and printings.

Don Quixote and Sancho spoke many of Spain's pithy proverbs. Castilian has changed much less since Cervantes's day than has English since Elizabethan times, and Spaniards use proverbs almost unconsciously in their daily speech.

At Madridejos I saw my first Quixote windmills. The two stone towers' vanes were still, but later I saw them working, the white sails tracing a latticed arc against the cloudless sky.

The revolving arms of a working La Mancha windmill recall vividly the atmosphere of *Don*

Quixote. The sails sweep round with a rushing beat of air, the wooden shaft and bearings creak and groan, and the ground throbs underfoot. One can almost hear, over the rhythmic menace of the vanes, the defiant shouts of Quixote as he charged the arm-waving giants, and the despairing cries of Sancho as his master was borne up on his lance and toppled from Rocinante (page 425).

With the black-smocked miller I climbed to the work chamber of a mill.

"All travelers from Madrid stop to look at the mill," he said. "Most La Mancha windmills are in ruins; few working ones are left, because power-driven mills in the big towns make it unprofitable to run these."

The building trembled and shook to the powerful sweep of the arms that passed and repassed the small window in the thick walls, throwing the lean face of the miller into alternate shadow and light. The round millstones growled as they ground the barley between their jaws.

Suddenly a gaunt greyhound bounded up the spiral stone stairs, adding another Quixote touch to the scene, for in the opening sentence of the novel Cervantes says that Quixote kept a lance, a shield, a nag, and a coursing greyhound.

Remembering the barber's brass basin that Don Quixote mistook for the magical golden helmet of Mambrino, I asked the miller whether such basins are still in use.

"Our barber doesn't use the old brass basin any longer," he said. "But they still employ them in some places."

"Have you heard the story of the barber and the walnut?" he continued. "Village barbers make the rounds every morning, and in fine weather they shave customers outside their own doors. This practitioner carried a walnut in his kit and gave it to the client to put in his cheek so that it would protrude and make it easier to give him a close shave."

Southward the road to Andalusia continues, through towns like Puerto Lápiche, also mentioned in *Don Quixote*, until it straightens again and points like an arrow across the fields to the church tower of Valdepeñas.

Grapevines Like Dry Soil

A vast web of vineyards surrounds Valdepeñas. Short grapevine stumps cover the plain with a network of regular rows that converge in the distance like tracks of a railway line.

Grapevines, like wine, do not like humidity, and they thrive in the loose, stony soil of La Mancha. Here they produce red and white Valdepeñas, the common table wine of Spain.

Shortly beyond Valdepeñas the flat country



Goya's Bullfight Etchings Portray Men and Moments Like These

The master himself might have painted the intensely Spanish profile of the *puntillero* (left), who wears a pigtail, mark of the bullfighter. With portentous dignity, the dagger man stands ready to administer the mercy stroke to the expiring bull. Pepe Luis Vázquez, one of Spain's leading matadors, has just concluded the contest in Sevilla's ring (page 426).

ends, and the road climbs in switchback loops to Puerto de Despeñaperros (Fling Down Dogs Pass), the gateway to Andalusia. At the height of the pass the road runs along the edge of a deep gorge. Far below, a small stream winds beside the railway line.

Where Don Quixote Did Penance

This is Sierra Morena, where Don Quixote did penance for love of Dulcinea del Toboso. Red-trunked cork oaks cling perilously to the base of fissured crags. Huge shoulders of schist, covered with patches of rust-red and cadmium-yellow lichens, rise sheer from the rocky stream bed. In these surroundings a band of cave-dwelling bandits, or a pants-less Don Quixote turning somersaults for love, become perfectly credible.

Descending from Despeñaperros, the road runs through increasingly frequent olive groves to Bailén. Here, during the War of Independence, Spaniards won a decisive victory over Napoleon when they captured 22,000 Frenchmen with a force less than half as strong.

The roads to Granada and Sevilla meet at Bailén, and here the Government has built one of its comfortable guesthouses. These

stand at strategic crossroads or halfway marks all over Spain, usually at points that would not otherwise afford good accommodations for the traveler.

At Bailén the traveler shifts accents, from "lisped" Castilian to the sibilant Spanish of Andalusia, a pronunciation more nearly like that of Spanish America, though the southern accent does not become truly marked until one reaches deep Andalusia farther south.

The main road to Córdoba and Sevilla swings west at Bailén, but I continued south on the route to Jaén and Granada.

Through a sea of olives I drove to Jaén. Silver-green olive trees covered the rolling hills as far as I could see. Halfway to Jaén the groves gave way temporarily to open fields, where red-stained buildings clustered around the openings of iron oxide mines.

The mining riches of Spain seem inexhaustible. Wolfram (tungsten), manganese, iron, potash, copper, lead, tin, zinc, mercury, all occur here. The Phoenicians mined copper in Spain, and the Romans extracted what Pliny called "liquid silver from stones." Yet the mercury mine at Almadén remains the world's richest.

Jaén huddles at the foot of a dramatic



"I Can't Beat a Woman at Haggling—Take the Eggs at Your Price!"

This sharp-tongued woman at Puerto Lumbreras, where the Mediterranean coast road branches inland to Granada, buys eggs from farmers, then crates them for shipment to Valencia and Barcelona. The countryman, who wears a black smock, corduroy trousers, and rope-soled canvas shoes, said he had lived in Ohio.

backdrop of mountains. High on the escarpments behind the city stand the well-preserved ruins of a Moorish fortress-castle. Though of ancient origin, Jaén today bustles with the prosperity brought by the olive groves that surround it.

Spain produces more olive oil than any other country, with nearly half the world's total output. A fourth of all the olive oil of Spain comes from Jaén Province; then follow the Provinces of Córdoba and Sevilla.

With a representative of the olive growers' syndicate I visited the town of Martos, west of Jaén. Ninety percent of the cultivated land around Martos is planted to olives.

"More olives come from this area," said my companion, "than from all of Greece. In Jaén Province we have 32,000,000 olive trees."

Andalusia suffers from a one-crop economy.

When the olive crop is good, there is prosperity in the land; otherwise, everyone suffers.

The olive expert took me to see the harvesting. In Sevilla, green or ripe eating olives must be picked carefully by hand; "milking" the trees, they call it. But here in Martos men were beating the black oil olives from the tree with long poles; kneeling women gathered up the fallen fruit in baskets (pages 428, 429).

At 1 o'clock all hands gathered in a clearing for lunch. As everywhere in Spain's rural areas, those nearest us politely offered whatever they were eating, saying, "If you like?"

The correct answer is, "Thank you. May it do you good."

One man cut the end off a small loaf of bread. Scooping out the soft crumb, he made a hollow into which he poured olive oil. He ate several of these and three or four oranges.

Olive oil, a superlative energy food, is rich in calories.

At the house of the proprietor of the olive grove I ate the regional dishes: *migas*, bread crumbs fried in olive oil; and a salad of orange slices steeped in oil.

Presses Squeeze Oil from Olives

To see the oil extracted, I went to an *almazara*. At the entrance to this mill an enormous mass of blue-black olives rose to the height of the roof. Inside, a huge conical roller ground up the entire fruit, including the pit, into a black gruel.

Workmen then spread the heated paste on circular pierced mats of esparto, a tough grass that grows in mountainous country, which is also used to make baskets, harness, rugs, and myriad other things. Threading the mat on the central column of a hydraulic press, they stacked others over it like a pile of flapjacks.

Already the man-high pile oozed oil, pressed out by its own weight; this oil and that from the first hydraulic pressing make the top-grade olive oil. The second and third pressings produce successively inferior grades of oil.

From the press the oil runs into a series of tile-lined vats. As it flows from vat to vat, water drains off at the bottom, and workers skim floating impurities off the top. The yellow-green olive oil, thus naturally settled and cleared, is known as virgin oil. Connoisseurs prefer this oil for cooking. Mechanical and chemical refinings later produce all stages of purity to the colorless, tasteless medicinal oils.

From Jaén the highroad continues through the mountains to Granada. On strategic high hills throughout this region stand square-sided stone towers. On these the Moors lighted signal fires to communicate from point to point.

Ruins and structures all over Spain record the passing of Romans, Visigoths, and 800 years of the Moors, all of whom have left their traces on the rich culture of the land.

On a series of terraces under the white line of the snows, Granada lies at the foot of the Sierra Nevada. Above the city, on its forest-clad hill, stands the Alhambra, the sprawling fortress-palace of the Moors. Completed in the 14th century, the Alhambra remained the stronghold of the African Moslems until the reconquest of Granada by Ferdinand and Isabella in 1492.*

At a time when nearly all Spain suffered from a severe drought, Granada was green and fresh with running water. The Moors built aqueducts and conduits to bring mountain spring water from the town of Alfacar to

the cisterns and fountains of the city, and the system still works.

The downtown business section of Granada is modern. But if one climbs the steep hill to the Alhambra and passes under an old arch into the dark woods, one enters another period in time. In the somber twilight under the trees, students bend over books on roadside benches and lovers walk hand in hand along the paths.

I entered the confines of the Alhambra through the great Justice Gate, a spearhead-shaped opening in the walls in the base of a massive tower.

In the spacious courtyard between the Moorish palace and the ugly unfinished Renaissance palace of Charles V, I saw groups of visitors, each with a guide intoning history in the language of his flock.

The Alhambra consists of a sprawling succession of rooms, porches, towers, galleries, and courtyards (pages 430, 442-3, 454). On the walls delicate calligraphy traced in stucco gives an air of fragility to the structure. From ceilings hang stalactites of plaster. I found these oppressive in their rococo excess; in contrast to the light and airy feeling of the pierced windows and arches, the heavy treatment of the ceilings weighed me down.

A plaque marks the suite of rooms where Washington Irving lived while writing his *Alhambra*. It must have been a pleasant place to live and write, overlooking the gardens and the city far below.

Nightingales Sing in Alhambra Gardens

One night I looked down on Granada from the hill of the Alhambra. From the balustrade on which I leaned, the hill dropped sheer to the first tiers of houses on the upper levels of the city. At street corners old lamps on scrollwork brackets threw keystones of yellow light divided by a black cross of shadow on the whitewashed walls. The city lay quiet, so still that the songs of nightingales rose clearly in the night.

Here in the Alhambra gardens and woods I heard these European night singers for the first time. Their liquid song resembles that of our mockingbird, but seemed softer, sweeter, less metallic. It was spring when I was in Granada, and several nights I heard three or four amorous males singing at the same time.

The Alhambra looks across a ravine to the old hillside quarter called the Albaicín. In its narrow, steep streets, balconies blossom with

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "On the Bypaths of Spain," March, 1929, and "From Granada to Gibraltar—A Tour of Southern Spain," August, 1924, both by Harry A. McBride.

pots of geraniums and carnations, and copper-smiths ply their trade (page 447).

In little plazas and at street intersections domed structures cover *aljibes*, the underground water cisterns built by the Moors. Subterranean conduits bring fresh water to the system of cisterns, and people draw water up through a door in the cupola as from a well.

About 2,500 of Granada's 166,000 inhabitants are Gypsies. To see them one must climb still higher from the Albaicin on the road to the Sacro Monte. Here they live for the most part in whitewashed caves hollowed in the soft rock (page 456).

Gypsies have been in Spain so long that no one remembers exactly when they first appeared. By now their dark good looks, spit curls, flounced dresses, and abandoned dances have become part of the Spanish tradition.

Spanish Gypsies are a bold, insouciant lot. They speak with the familiar *tú* immediately on meeting one, and have a glib tongue.

"All Gypsies," they say, "are direct descendants of Jesus Christ, and for that reason we are privileged to live without having to work."

Out of the green valley of Granada and over arid hills I drove east toward the Mediterranean coast and Valencia. The automobilist in Spain must look out for big stones left on steep roads by carters. Drivers use the paving-block-sized stones for chocks when they stop their tandem mulecarts on a hill.

The road from Granada joins the main north-south Mediterranean coast highway at Puerto Lumbreras. Just before entering this town I stopped at a thatched shelter to watch women pack mounds of white eggs in straw for shipment to Valencia and Barcelona.

One countryman, wearing a black pleated smock and sitting cross-legged on full saddlebags, rode up (page 436). Eying my license plates, he asked, "French?"

I told him I came from the United States. Suddenly lapsing into English, he said, "I once spent four years in Ohio."

North along the coast the road runs through Murcia, center of a fertile plain crisscrossed with irrigation canals originally laid out by the Moors. Noted for its silk production since the Middle Ages, Murcia is the world center for silkworm gut, the filament used in fishing and for some surgical sutures.

To make gut, culturists do not wait for the silkworm to spin its cocoon. They take the worm at the moment it prepares to spin, kill it and toughen it by immersion in a vinegar solution, then split it open and draw the two silk sacs out into threads 12 to 16 inches long.

Farther north I passed through Elche, with

its forests of palms. Growers tie cloths around the palm fronds to keep them from the sun. The fronds, almost bereft of chlorophyll, remain a pale white for use on Palm Sunday.

Then comes the port of Alicante, and finally the flat *vega* (cultivated plain) of Valencia.

From Alicante north, people speak Valencian, a dialect of Catalan. Catalan has nine vowel sounds, including two *a*'s, three *e*'s, and two *o*'s.

For miles around Valencia the flat country is a succession of rice fields. Vivid green stalks project from blue water as far as one can see, and stooped workers standing knee-deep in water increase the similarity to an Oriental scene.

Close to the big seaport stretches the lagoon of Albufera, a large fresh-water lake. Separated from the sea by a narrow neck of land, Albufera is rich in fish life and aquatic birds. In season, duck shooting becomes a major occupation and pastime here.

Canals lead from the lake to villages and hamlets, and sailing boats with triangular sails appear to be sliding along on dry land when progressing across the flat landscape.

How to Catch Baby Eels

At Perellonet (the Valencian names sound strange after Castile), at one of the outlets to the sea controlled by sluice gates, I watched fishermen dip up *angulas* one night. *Angulas* are two- to three-inch elvers, the transparent young of eels.

The scene was like something from a Japanese print. Two wavering lines of light showed where fishermen, in boats with candle lanterns, scooped up the invisible elvers by making methodical sweeps with a fine-meshed screen dip net.

Fishermen later throw them in water with a pinch of powdered tobacco.

"The nicotine kills them," one man told me. "Then we boil them for a minute or two and dry them between folded cloth."

Thus prepared, they look like bean sprouts or dry noodles. Restaurants fry them in olive oil seasoned with garlic and hot peppers.

Valencia is one of Spain's many gastronomic oases. Here one may get grilled cuttlefish, fried squid, and broiled Dublin prawns. But the great local specialties naturally center around rice, prepared in twenty ways. The *paella* leads all the rest. *Paella*, a meal in itself, is a noble dish of rice flavored with saffron and contains chicken, squid, mussels, clams, crayfish, prawns, and snails.

I had always thought I could hold up my end at table, but I found I was an object of concern to my Spanish friends.



Valencia's Festival Queen Displays Golden Comb, Hair Skewers, and Sequined Lace Shawl

The queen (left) wears silk brocade, for which Valencia was already famous in the Middle Ages. Today this opulent finery appears only on Valencian holidays, such as March 19, St. Joseph's Day.



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Illustration by Lois Marden

♣ Wineskin Drinkers Need Keen Eye, Steady Hand, and Pursed Lips

A Basque starts the flow close to his mouth, then lengthens the jet. To stop, he brings the nozzle back to his lips and upends it suddenly. Goatskin bags are waterproofed with pitch applied to the hairy inner side. Like casks, they need to be broken in with waste wine.

✧ Spain's Five-pound "Ox of the Sea" Has Spreading Hornlike Claws

This tasty crab (*Cancer pagurus*), caught in the Bay of Biscay, is identical with one found off the British Isles. Spaniards, who love shellfish, also consume enormous quantities of shrimp, prawns, clams, mussels, oysters, goose barnacles, and three kinds of lobsters.





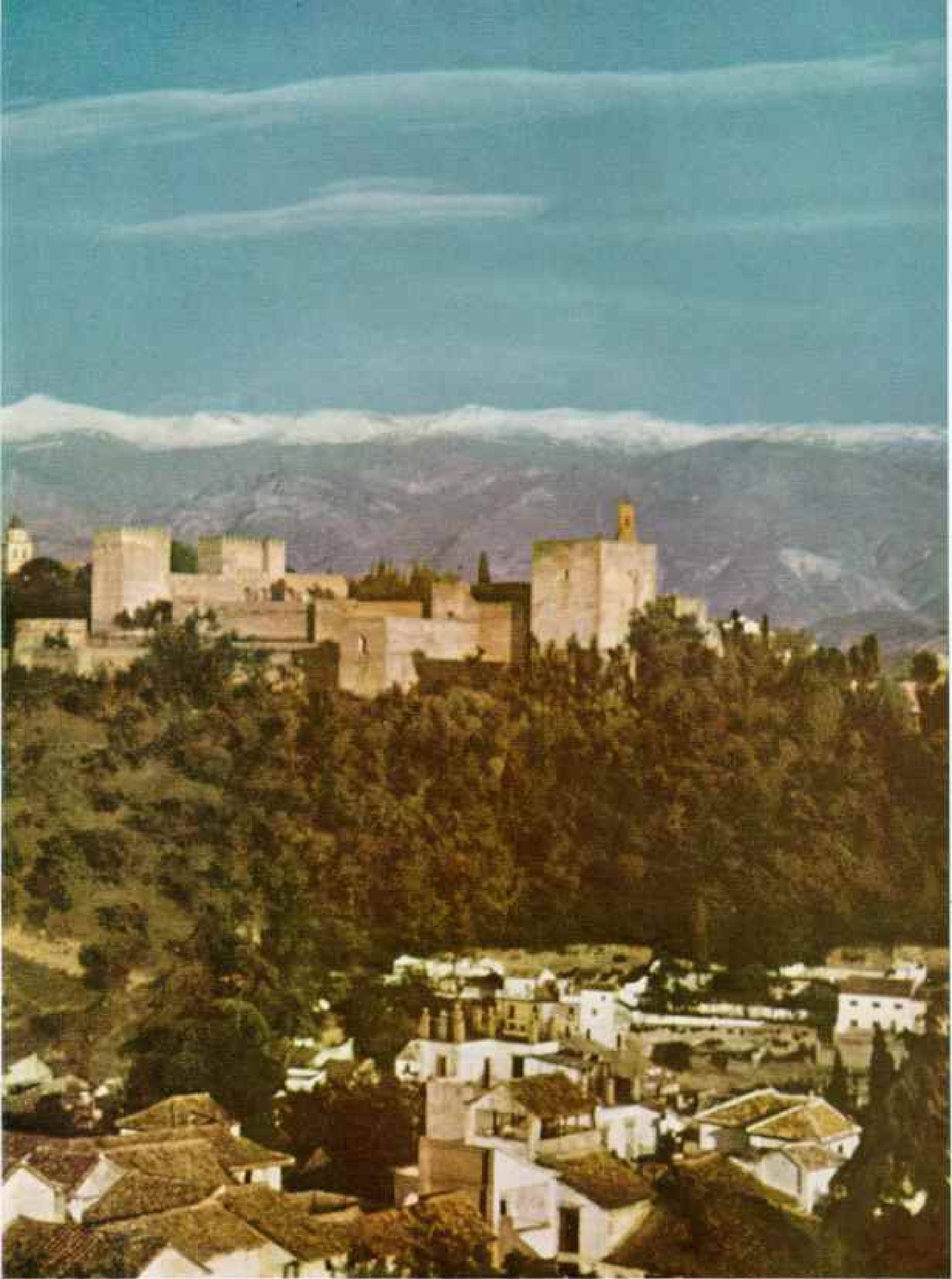
The Giralda, Built by Moslems, Beloved by Christians, Is Seville's Emblem

Twelfth-century Moors built the tower as a minaret. They installed a ramp instead of a staircase, so that horsemen might ascend abreast. Two contemporary towers in Morocco are counterparts of the Giralda.



From the Arabic Word for Red Comes the Name of the Alhambra

Sunset intensifies the ruddy hue of the fortress-palace. Moorish conquerors of Spain built it, mainly in the 14th century. Am'd its gardens stands the Generalife (extreme right), country house of the Granada caliphs.



Beyond the Alhambra's Hill Stretch Sierra Nevada Snows

Each January 2, anniversary of the reconquest of Granada in 1492, girls in search of a husband ring the bell of the tower at right. Washington Irving in 1829 wrote *The Alhambra* while living in the palace.



Around the Goddess Cybele's Lion-drawn Chariot Surge the Buses, Taxis, and Private Cars of Madrid, Spain's Capital
This city of a million and a half is expanding rapidly. Madrid and Barcelona, Spain's most important cities, keep neck and neck in a population race. The American-built Telephone Building (right background), Madrid's highest, withstood shot and shell during the Civil War.

Castanets Rattle and Brilliant Skirts Flare as Murcia Dancers Whirl to Singing and Guitar Music.

These girls from the eastern Province took part in a regional folk-dancing contest in Madrid. Sometimes Spanish dancers snap fingers instead of castanets. Northern Spain's dancers perform with sober geometric precision; Andalusians with fiery abandon.

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Illustration by Lutz Maerten



Gilded Hoofs Clatter; the Moors Ride Again

For eight centuries the Moors, as Spain calls Moroccan Mohammedans, dominated the country. By A. D. 718 they had conquered almost the entire Peninsula.

Tenth-century Córdoba, with half a million inhabitants and hundreds of mosques, became one of Islam's greatest capitals. While Christendom languished in the Dark Ages, Moorish Córdoba kept alive the arts and sciences. Moslem power waned in the 11th century; but Ferdinand and Isabella, who championed Columbus, did not recover Granada, the Moors' last citadel, until 1492, the year of America's discovery.

These resplendent Moors guard the Spanish Chief of State, Generalissimo Franco, on ceremonial occasions. Here they ride to the reception of a South American ambassador. Hoofs of their Arabian mounts are gold-painted.

✓ In Old Granada

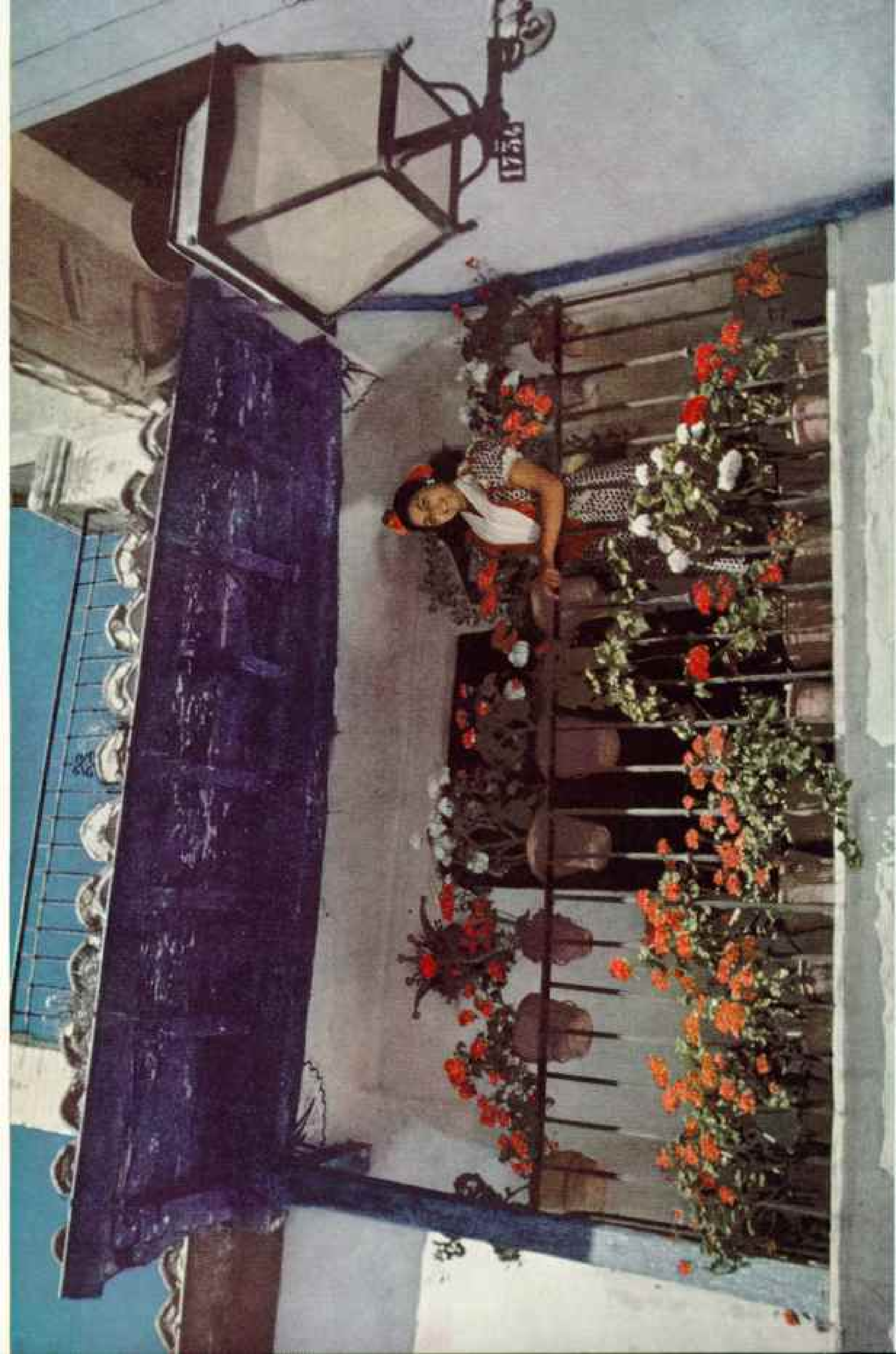
Potted flowers, iron-railed balcony, and brunette Gypsy express the charm of the Alhambra quarter of this old Moorish city. The antique gas lamp has been wired for electricity.

Most Gypsies, who speak a Romany dialect in addition to Spanish, live in caves on the Sacro Monte. The men trade horses and mules at fairs in Andalusian cities.

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Reproduction by John Marden

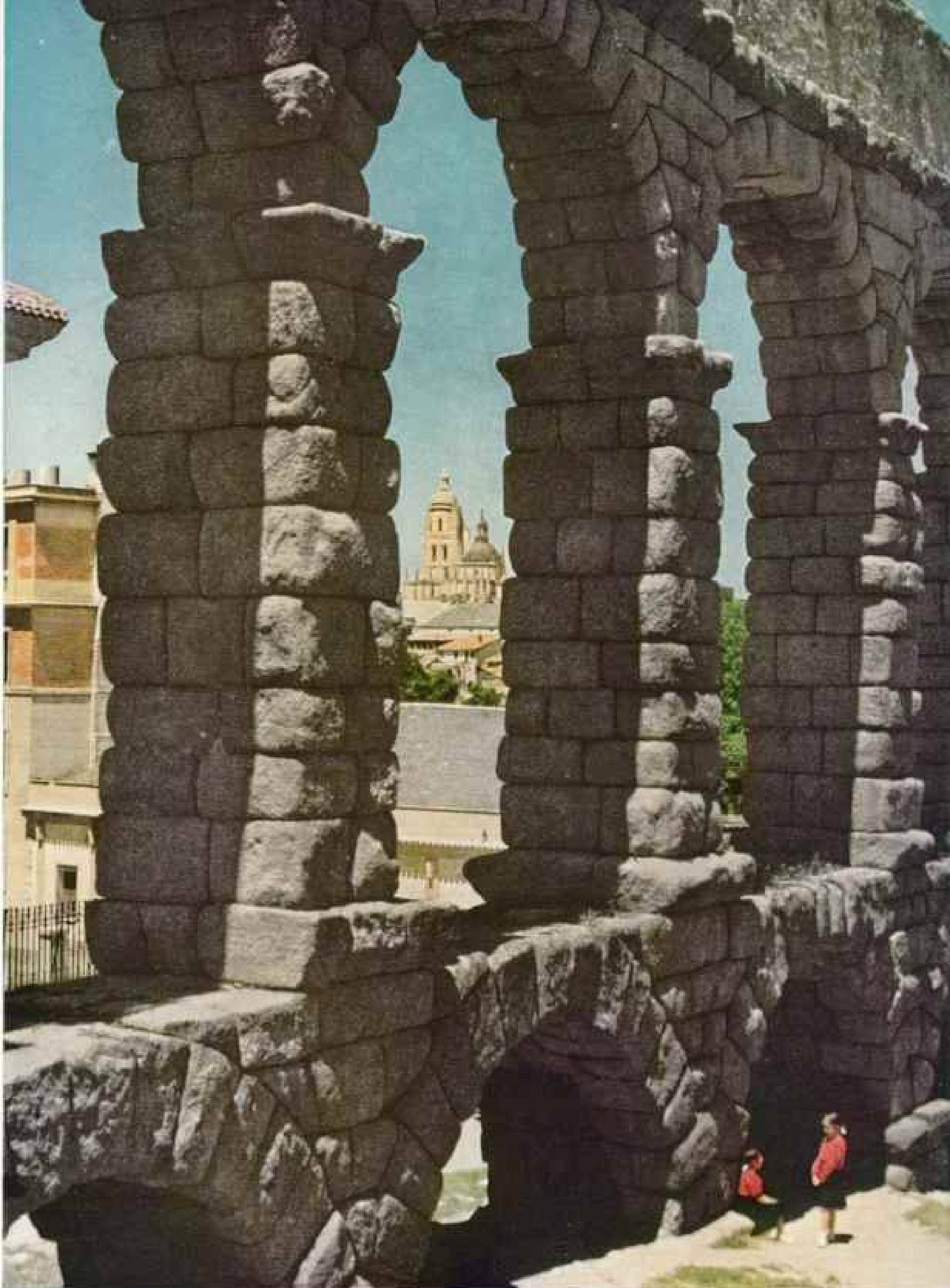






Earthen Homes of Cave Dwellers Stay Cool in Summer, Warm in Winter

Spain for centuries has had entire communities of troglodytes. This cave near Granada appears small and gloomy, but actually has 22 comfortable rooms. The chimney (upper left) springs out of the ground.



Graceful Arches of Segovia's Roman Aqueduct Have Stood for 20 Centuries

Assembled like Inca masonry without mortar or cement, the granite stones fit perfectly. Water flowed through the conduit until recently. Segovia's Cathedral, favorite of artist Ignacio Zuloaga, appears through the arches.



Madrid's Busy Puerta del Sol, Heart of the Imposing Capital City, Symbolizes Spain's Vitality and Gayety

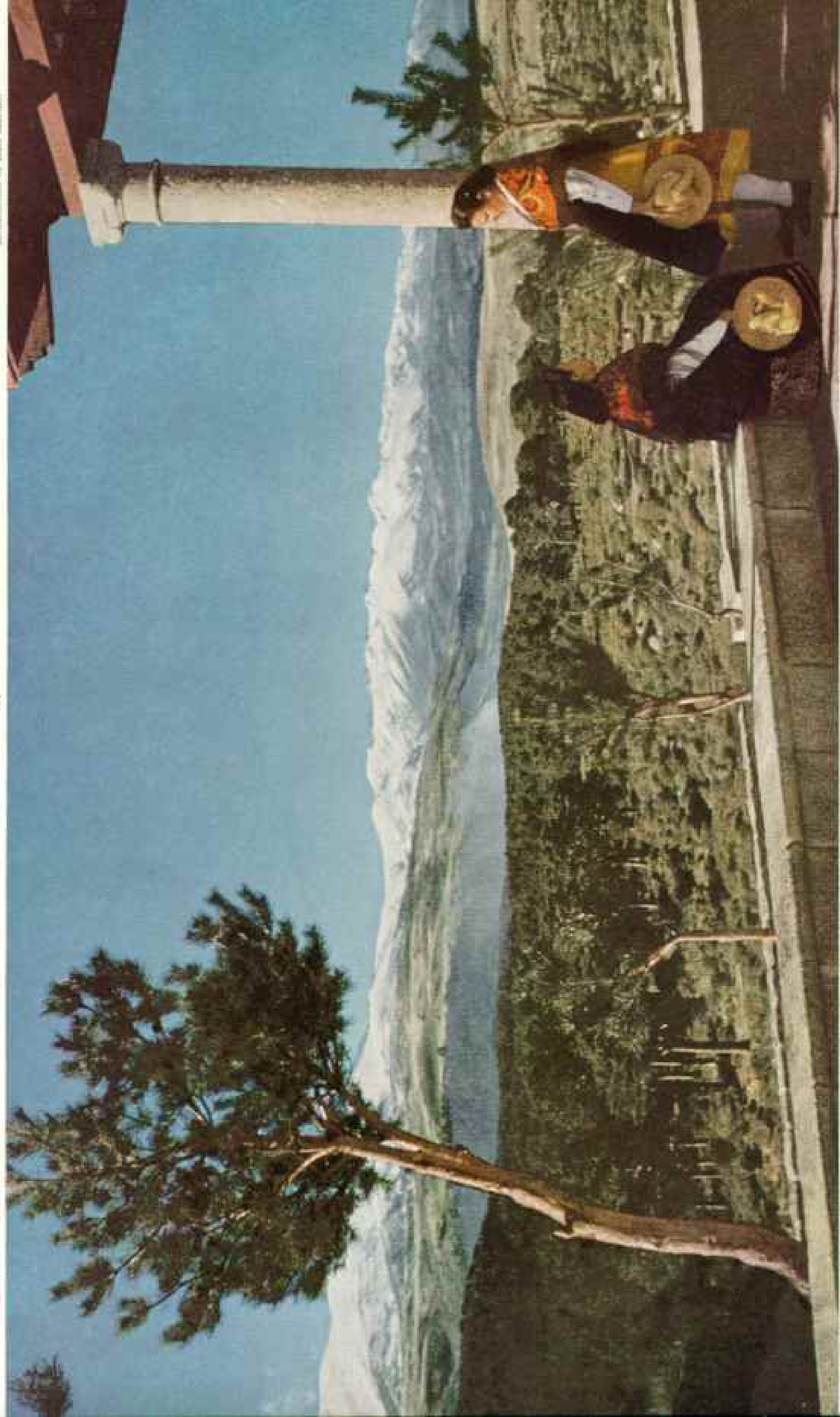
Ibex and Trout Live in the Snows and Streams of the Glittering Sierra de Gredos

From this Government hotel terrace, guests look across the valley of the trout-filled Tormes River to 8,500-foot peaks of the Sierra. Girls wear Ávila dress.

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Illustration by Lella Mardian





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Illustration by Emily Mardon

Sevilla's Bitter Oranges, Source of Marmalade, Take Southern Sun to England and Scotland

Indefatigable bitter oranges combine with sugar to make Britain's famed bittersweet marmalade. Spain imports most of its marmalade from England. Together with olives, olive oil, and cork, oranges form an important Sevillian export. These women wrap and crate the fruit for shipment.

Oranges and Good Looks: Two Valencia Specialties

Valencia grows three kinds of sweet eating oranges: a small native, the blood orange (below), and the navel, which comes from California stock.

© National Geographic Society



His Three-cornered Hat Is Made of Patent Leather

Spain's Civil Guards, famed for iron discipline, police the country roads in pairs. This sergeant wears gala uniform for Sevilla's Fair.

Rehearses by Enla Marden





Spain's Finest Example of Moorish Architecture Is the Alhambra's Court of the Lions

Travelers from all over the world make pilgrimage to view the celebrated patio. Ancestors of these Granada Gypsies camped in the ruinous Alhambra until reconstruction began in 1828. Crudely stylized lions of the fountain suggest the tolerance of Moslem Granada, for Islamic artists are usually forbidden to create "idols."

"You hardly eat enough to keep alive," they would say. "Eating is like scratching; it's all in getting started."

Valencia specializes in fireworks. So much is the city addicted to "artificial fires" that I could not be sure, when approaching Valencia by night, whether flashes beyond the horizon came from lightning of an approaching storm or from rocket explosions.

In the spring I returned to this third city of Spain for the celebrated *Fallas* de San José (St. Joseph). Festivities last for five days and center around elaborate humorous or allegorical life-size figures, in papier-mâché and wax, built on stages at street intersections.

The Valencians work all year to plan and build these fallas, or graphic satires; but all of them, big and little, go up in bonfires on the night of San José, March 19.

Men soak the paper, wax, and wood structures with gasoline, and in a moment the falla becomes a roaring conflagration. When I wondered aloud why the pavement beneath did not crack with the heat, friends told me that each falla rests on a layer of deep sand.

As the fallas burn, rockets scream upward from the roped-off central square to explode with window-shaking noise and brilliant colors. The noise builds up until, with the final salvo, everything shudders and quivers under the terrific impact of sound. Valencians love it.

"When our children are only two or three years old," a municipal official told me, "we take them in our arms and run with them under strings of exploding firecrackers, dodging the falling fire, so that the young ones will get used to it."

Bonfires at a Wedding

Fireworks and bonfires go with Valencians from medieval times. Many Valencians served in the army of Cesare Borgia, and on the occasion of the marriage of Cesare's sister Lucrezia to the son and heir of the Duke of Ferrara in 1501 the Valencians lighted bonfires in the plaza of St. Peter's in Rome.

Valencians display artistic talent in things other than fireworks. Here the first book printed in Spain appeared in 1474. The novelist Vicente Blasco Ibáñez and the painter Joaquín Sorolla y Bastida were Valencians. And virtually every fine house in Spain possesses examples of the exquisite furniture turned out by Valencian cabinetmakers.

Center of the richest agricultural part of Spain, Valencia prides itself on its oranges; yet I found that local people prefer the thick-skinned navel oranges of California origin. Conversely, some Americans would rather eat Valencia oranges (page 453).

When I think of Spain, I like best to remember Madrid at Christmas and New Year's time. In the Plaza Mayor, the old enclosed Great Square, booths spring up then to sell holly and other Christmas greens. In this square lingers the flavor of *castizo* Madrid. "Castizo" is a difficult word to translate; it means "pure," "authentic," "traditional."

On one side of the Plaza, above the ponderous arched galleries and the uneven flagstones, rise twin spires that display two dials: on the left a clock, and on the right a huge barometer which always forecasts the weather correctly. The hand invariably points to "Variable."

At night an old woman sat under an arch roasting chestnuts, her face lighted ruddily by the charcoal brazier at her feet.

"How do you sell the chestnuts, señora?"

"A fat bitch apiece, sir."

A fat bitch is ten cents; a plain bitch only five.

Noisemaking on Christmas Eve

I bought some chestnuts and moved on. Under the gallery they were selling tambourines and drums, for Christmas Eve means a time of noisemaking in Madrid. I looked at one two-foot-wide tambourine covered with black script; the maker had used the vellum page of an old missal.

Streets surrounding the Plaza Mayor run on a lower level. From them the walls of the buildings forming the closed square rise like the ramparts of an ancient fortress.

To support the tremendous weight of stone, the massive walls are thicker at the base, so that they lean inward from the sidewalk like the pylons of an Egyptian temple. Small, heavily barred windows pierce the forbidding façade, and a flight of worn steps, called the *Graderillas*, leads upward through an arched embrasure to the square.

As I watched, two men muffled to the chin in cloaks emerged from the darkness of the stairs and walked after their shadows in the yellow lamplight.

Farther down this street I looked through the misty window of Botín's restaurant at the pale smug faces of suckling pigs, nuzzling each other for a turn at the 200-year-old oven inside. All about me cocks crowed. Madrider were fattening them for the New Year.

On New Year's Eve I went with three friends to the Puerta del Sol (page 450). By a quarter to 12 it seemed that all Madrid had crowded into the square. People converged on Sol from side streets, and more surged up out of subway entrances. Some were beating



This Is Spain: a Granada Gypsy Dances in Her Cavern Home

At this *sambra*, or dancing exhibition in the Sacro Monte quarter (page 438), the dancer's companions clap palms together to accentuate the rhythm of four guitars. The girls' mother, nicknamed La Faraona, circulates with the sherry bottle. On the cave's whitewashed ceiling hang copper utensils, products of Granada:

tambourines and drums, others singing and dancing. As midnight approached, the roar from the packed multitude swelled to the sound of surf on a rocky coast.

We fought our way to the roof of an office building. From here the Puerta del Sol seemed one compact mass of humanity.

One of my friends pointed to the illuminated clock dial on the tower across from us.

"You know the custom? At midnight everyone tries to eat twelve grapes, one for each stroke of the clock."

He handed me a cellophane packet containing the twelve grapes. It was less than a minute to midnight. The noise of the crowd

fell several notes to a curious expectant hum, and the black mass became stippled with pink as faces looked up at the clock tower.

On the stroke of midnight a golden ball in the clock tower dropped, and the clock began to strike. All of us solemnly popped grapes into our mouths in time with the deep-toned bell. As the last stroke faded away, sirens and whistles blasted a welcome to the New Year. My friend turned to me.

"Did you swallow all your grapes?"

I gulped and said, "Yes."

"Then your wish, whatever it is, will come true."

I wonder.

Arizona Sheep Trek

BY FRANCIS R. LINE

With Illustrations from Photographs by the Author

I SHALL not soon forget the sight of Rosalio Lucero, the herder. His ravined brown face is a relief map of his Arizona hills. At more than threescore years his hair is still as black as the charcoal embers of his campfires, and his teeth are as white as bleached bones on the desert. Years of leaning on a herder's staff have sculptured his shoulders into the curve of the staff itself (page 474).

Rosalio dresses in dusty bib overalls and jumper, which flap grotesquely as he runs in pursuit of an errant sheep.

No, Rosalio does not remotely resemble a hero; yet twice a year he performs a hero's job, guiding his migrating herd across desert and mountains.

Heat and Snow Goad the Herd

By mid-April Arizona's Salt River Valley is beginning to scorch. For men there are excelsior-and-fan cooling systems, but for sheep, grazing in irrigated fields, the only air-conditioning lies in migration.

From 1,100-foot-high pastures around Phoenix the herds start trekking to cool summer pastures above 8,000 feet in the White Mountains, close to the New Mexico border (map, page 459).

For sheep and herders the annual trek means some 50 days of grueling struggle upward each spring, and an equally exhausting journey downward when autumn's snows drive them from the mountains. Climate's stern demands keep the herds trail bound more than a quarter of the year.

The migrants follow the Heber-Reno stock trail, a long, pathless strip two to four miles wide. Here and there the trail is so tangled that even experienced herders occasionally become lost (page 458).

Only a few weed-grown roads cross the trail along most of its length. For 30 days we touched no private property. Fences are 50 miles apart.

On the trail I was to see the seasons reversed within a week, ice succeeding summer's fiercest heat. Lizards sun-bathing in the desert gave way to deer bouncing through shady forests. Cactuses dissolved into giant pines.

To take pictures of the trek, I appeared before sunrise one April 16 at the camp of the Paradise Stock Farm near Chandler, Arizona (page 460).

My gear was stowed aboard a burro (page 477). Our expedition's seven pack beasts were placed in charge of Pablo Chavez, a 42-year-old *campero*, who was to make our fires, cook our meals, and tend the burros for the next 52 days. Cheerful Pablo had the strength to load and unload his seven recalcitrant burros four times a day, and the ability to shoe a horse or dress a wound.

As the herd poured out of the home pasture, its owner took a tally showing that Rosalio had 1,547 wards, including a few goats selected for leadership (page 477). All the sheep were ewes, freshly shorn. No rams made the trek on hoof; pampered males went by truck and railroad.

Into an unpaved highway the sheep flowed like a river of fleece. Soon 6,000 hoofs churned up a dust cloud which hung over the herd like a lazy balloon (page 463). Ahead and behind, more dust clouds identified other trekking herds.

Rosalio, who had to walk with the sheep while Pablo rode, choked on the highway talcum all day long. By night he was coughing and exhausted.

Animal Bridge Spans Salt River

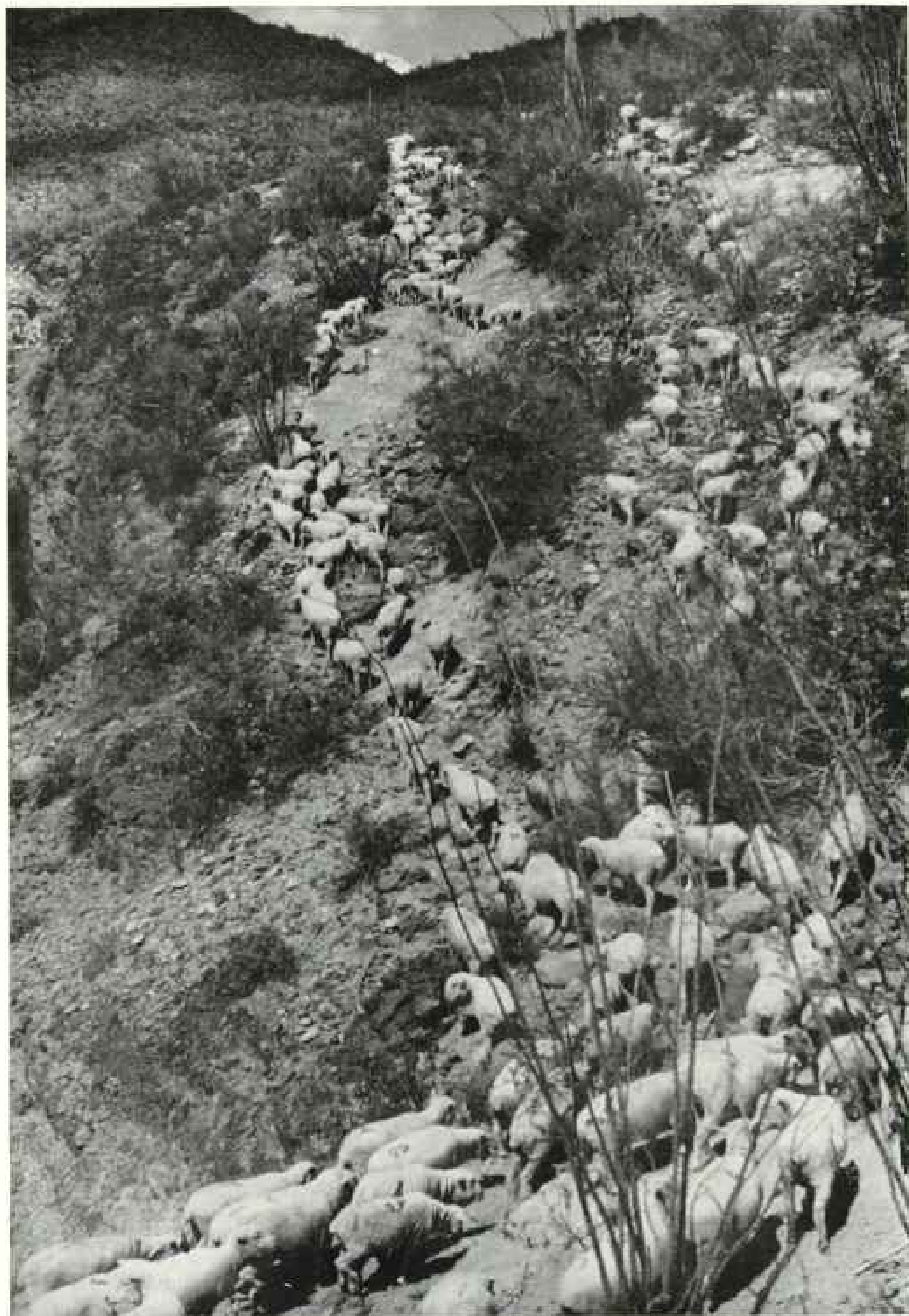
Our first stretch of desert, which we entered on the second day of the march, provided relief, for it was less dusty. That night we camped beside the Salt River and drifted to sleep on the tinkle of sheep bells.

In past years herds swam the river, losing occasional members; but we had the advantage of the sheep bridge, a narrow suspension span designed for stock (page 461).

When, on our third morning, the herd swung into a corral beside the bridge, Pablo laid out his camp and began cooking in restaurant quantities, for he had extra mouths to feed.

First of our guests were the herd owner, his wife, daughter, and son-in-law who drove in with canned goods for the herders and salt for the sheep.

Next, a Federal ranger arrived in pursuit of a census matter. As part of the sheep trail crosses the Tonto National Forest, for which the Forest Service charges a fee per head, the bridge provided an opportunity to count the herd as it streamed across. Now another outfit arrived with a herd encumbered with a mortgage. With it came a finance company's agent to tally his mobile collateral.



One of Arizona's Toughest Trails, the Abandoned Reno Road, Takes the Herd Uphill
Built in Indian days, the road leads to Old Fort Reno, now a ruin. It wrecked many an Army wagon.



Drawn by Harry S. Oliver and Levin E. Altman

The Sheep Trail Ziggags Across 200 Miles of Arizona Wilderness

Twice a year thousands of migrating ewes follow the Heber-Reno stock trail. Each spring they quit the desert floor near Phoenix and seek cool pastures in the White Mountains. In autumn they retrace the course. Their "highway" is a narrow, pathless strip of public domain and private range so tangled with canyons and encampments that herders often get lost. Rams travel by truck and train.

Literally, the bridge was a countinghouse.

At noon we filled our plates with frijoles, mutton, and pan biscuits, and for an hour the men wove woolly yarns about the trail. This was the herders' last social fling for weeks.

Bridge Shakes; the Herd Stampedes

Presently Rosalio opened a corral chute leading onto the bridge. The herd leaders hesitated, but the impatient woolly mob stampeded them onward (page 476).

Shakily hung from cables, the bridge writhed and trembled, terrifying the sheep. Running, pushing, and bleating, they raced two abreast in a runway designed for single file. When they approached solid ground they leaped for joy, circus-fashion (page 464). Burros showed fear of the vibrating span by freezing in their tracks. It took the herders half an hour to tug them across.

Now good-byes filled the air; the herd was off into the wilderness.

We stopped at 9 that evening. Pablo hobbled the burros, opened the pack boxes, gathered wood, and lit a fire. Canned corn, frijoles, coffee, and midday's remaining biscuits made our meal. Sorghum syrup was dessert. Then we tossed the scraps to the dogs, Boots and George (page 474), and washed the dishes. With his flashlight Rosalio checked the herd, bedded down around camp.

It was 10:30 before we fell into our bed-rolls.

Campfire lit a circle around us. A 40-foot saguaro cactus stood watch on our left.* Opposite it a scarlet-headed ocotillo, one of the candlewoods, swayed in the breeze like a Hawaiian dancer.

All about us was silence, but not emptiness; solitude, but not loneliness. There was no noise or confusion. Civilization's worries faded.

A glance at the sky revealed the glory of the desert night. The stars, magnified by clear air, burned in brilliant array. By their light I could tell time and scribble notes. On other nights, by moonlight, I could actually read.

We arose at 5 for breakfast of pan bread, stewed fruit, and coffee. With the first gray light Rosalio and I started off with the herd, leaving Pablo to pack the burros.

Sunrise brought a cloud of gnats swirling blackly around the tender faces of the sheep. Half an hour of this torment stopped the herd. Each member buried her head in her neighbor's flank and refused to budge.

Rosalio shouted threats to no avail. Nor did it help when he tossed sticks, gravel, and even his blue jumper into the air. Finally he signaled his dogs into action. Then the mass of gnat-pestered wool drifted a few hundred yards and halted again (page 465).

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Saguaro, Cactus Camel of Arizona," by Forrest Shreve, December, 1945; and "Saguaro Forest," by H. L. Shantz, April, 1937.



The Author Before His 52-day Ordeal

After the trek Mr. Line weighed 11 pounds less. Walking across stony deserts and mountains, he wore out two pairs of shoes. This lamb, born in winter pasture near Chandler, Arizona, did not make the long journey with the ewes.

Now Rosalio, laboring once more, drove the herd into the most gorgeous and awesome cactus country of the entire trek.

Some cactus plants befriend the sheep, providing bud and blossom for forage where grass is lacking. I have seen a starved ewe painfully shredding and devouring the pulp of a prickly pear.

Other cactuses are bitter enemies. Among these is the cholla, frequently called "jumping cactus" (page 468).

On a ridge glowing with an opulent but wicked green we now faced a low forest of chollas. Fat spines, back-lighted, stood out against the rising sun. At a distance the

cholla was a cactus with a halo. Underfoot it proved a devil's pitchfork.

Into the mass of glistening torture, too widespread to detour, the sheep drifted as if unaware of their danger. Suddenly one of the lead ewes, stung by spines, leaped into the air as if on springs. Landing on her companions, she tried to retreat across their backs. A moment later the senseless herd blindly shoved its leaders deep into the thicket.

Despite my own caution, two spines stirred by my feet shot up and struck me in the legs. Jumping cactus made its name understood. When I moved, each poison lance felt like a needle dipped in fire. Grasping my denim jeans, I jerked some spines free, but not all. I longed for a pair of pliers, man's best friend in cholla land.

For the sheep there was little we could do. In a few days their festering wounds expelled the spines, with no injury.

Frequently I saw Rosalio burning off cholla around our campsites, the blazing plants lighting up his angry face. He hated cholla as he would a personal enemy.

Next to cholla, we detested the desert rocks—sharp, broken, rough, every one (page 469). By morning of the third day's hike I felt them jabbing through thinning shoe soles. I was thankful that Rosalio, our cobbler, had packed a shoe last and sections of old rubber tires.

Now the sheep, plagued by gnats, cholla, and stones, paused in exhaustion. I was equally worn out. By 9 a. m. dawn seemed ages in the past. Pablo, moving up with his refreshment-laden burros, was a welcome sight.

Pitching camp, we shaded up for the heat of the day (page 466).

At midday's halt the herders accomplished their chores, mending shoes and cleaning pack boxes. Rosalio hospitalized the dogs, whose paws were sore with cholla spines (page 469).

Pablo now did most of the day's cooking in a portable Dutch oven.

After lunch Rosalio got out tablet and pencil.

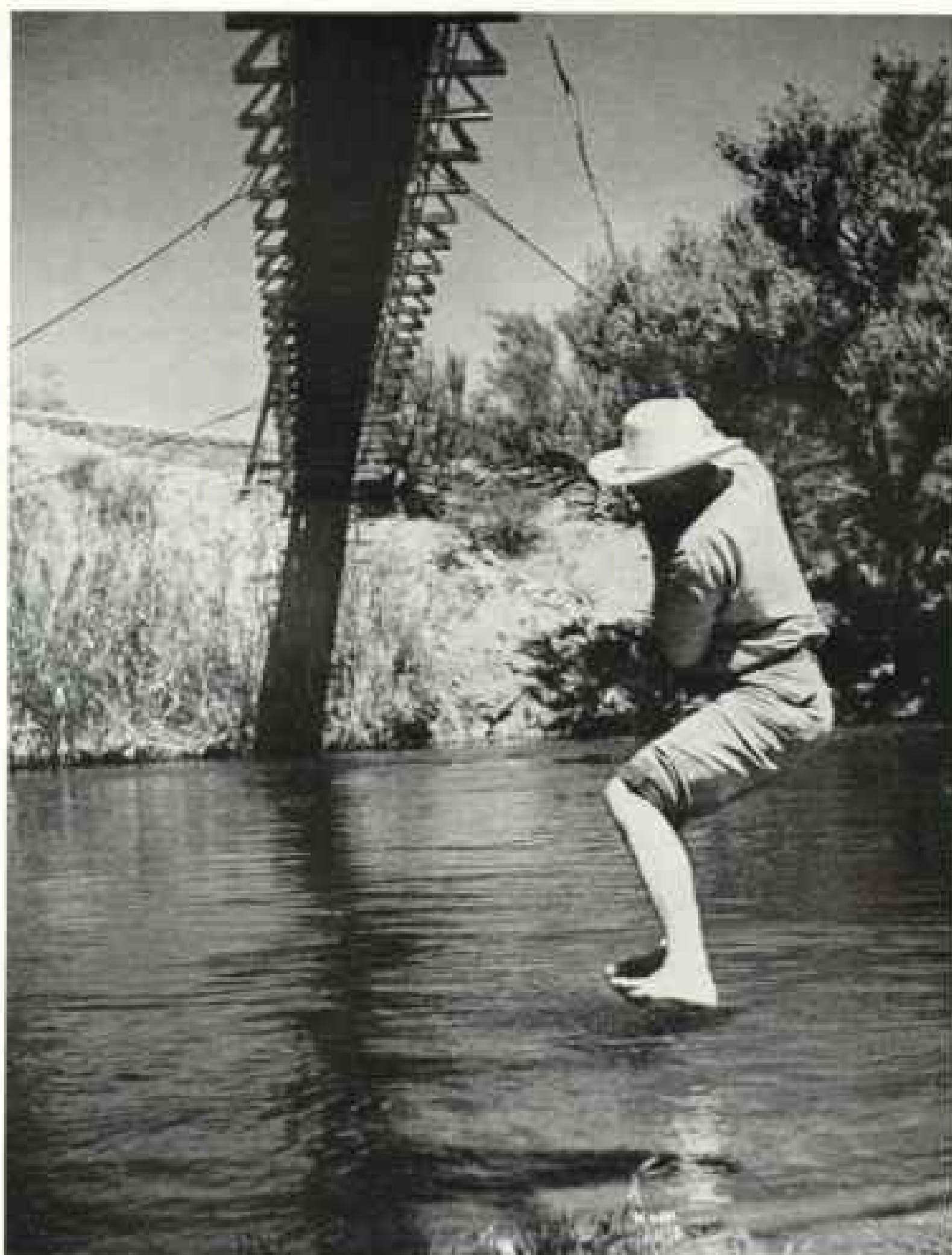
"Four times a year," he told me, "I write my sister in Albuquerque." When he had finished his letter, he took a siesta, in which I joined. By 3 p. m. we resumed the trek.

Thirsty Herd Sprints for Water

Such was the pattern of our lives for the next several days. As we moved on, the wilderness burst into flower. Paloverde trees blossomed into saffron. Each variety of cactus put forth a bloom (page 468).

Three days from the Salt River the herd broke its thirst in a creek. The next drink cost three more days' trekking. As we approached Rock Tank, the sheep had gone dry for another 72 hours. Thirsty and weary, they were barely plodding along when, half a mile from our goal, the lead ewes smelled water. In a moment the entire mob was stampeding across the hills (page 470). It was a joy to watch them slake their thirst.

As the tank was about two miles from a dirt road, the herd owner was able to meet us with fresh provisions. With him came my wife and daughter Adrienne, then 10 years old, who camped with me that night under the stars (page 463).



A Sheep Owner Playfully Swings Out over Salt River

For a day the sheep rest beside the river before starting the cruel march into the desert. Owners, campers, rangers, and creditors meet beside the bridge to take a census of the herds (page 457). They devote idle hours to gossip and horseplay. Here Irving Gibson ventures out from shore on a rope.

Adrienne was so thrilled that next day she wrote:

SHEEP

Under Arizona's great blue sky
On winding trails the sheep pass by.
Into the valleys, up mountains steep,
Traveling steadily come the sheep.
Down to the river to water they run,
To conquer their thirst from the long dreary sun.
They wind their way through cactus spines,
And journey by forests of tall stately pines.
In mountain meadows then they roam
And each sheep has earned its summer home.

Two days of climbing took us to the top of Reno Pass, where we camped. Spread out for

miles before us lay Tonto Basin, one of America's wildest sections.

In the morning I let Rosalio go his way alone so that I might stay and photograph Pablo packing his seven burros.

Perhaps some herders are lazy, but not Pablo. Morning, noon, and evening he loaded or unloaded all the heavy kyack boxes, along with bedrolls, water kegs, shovels, and axes.

These packs carried virtually all the herders' personal possessions. Save for one vacation a year, they devoted their lives to the sheep.

Packing completed, Pablo fed his horse, unhobbled his burros, and set out to establish noon camp. We faced three days of tough going before we reached water at Tonto Creek (pages 469 and 471).

From Tonto Creek it was up, up into the foothills of the Sierra Ancha. For nine days we journeyed without sight of road, fence, or house.

Now the trail led us onto a tableland floored with dry filaree, paloverde, and isolated cactus. At a higher level greasewood shrubs atomized the air with fragrance. Atop a giant mesa we found a sprinkling of junipers. The altimeter of changing vegetation registered our ascent.

One morning lizards played hide-and-seek with me as I advanced. Startled grasshoppers, jumping ahead, measured my strides.

Heat Pursues the Caravan

As the sun climbed, so did the heat. Cupped between the Sierra Ancha ahead and the Matzals behind, our caldron boiled. At noon we found two thin paloverdes for shade. Burros, dogs, and humans, each sought relief in vain. Lying down, I exposed my shoe soles to the sun; I thought my feet would fry. We had no thermometer but the rising mercury of perspiration. Two days before it was 110° F. in the shade in Tonto Basin, and here it was hotter, with no shade.

Below our camp the sheep broke into tiny bands, each group sheltering behind a bush. It was 5:30 before Rosalio had the heart to start them moving.

As we were too hot and weary to carry canteens, I was surprised half an hour later to hear Rosalio ask, "You want a drink?"

Venturing into a darkening canyon, he led me to a small rock-lined pool. Lying on our bellies, we plunged our faces into the clear water. As I paused for a second drink, I caught the reflection of the dogs, drinking too.

Yellow jackets lit on the water, balanced themselves much like us, and dipped their heads. Their thick sterns throbbed like pumps. We did not bother them, nor they us.

Thirst quenched, I discovered several thousand tiny eggs, shining like pinheads at the bottom of the pool.

Overtaking the herd, we encountered four rattlesnakes.

Woolly Army Routs Rattlesnakes

Behind the 6,000 hoofs of the herd, rattlesnakes were no danger whatever; they were dead or deep in hiding. But I often journeyed ahead, and so encountered many snakes; not once was I molested. Rosalio told me that in all his years no rattler had ever harmed him. To Pablo they were the "gentlemen" of the reptile tribe, always giving fair warning. He never went out of his way to kill one.

Occasionally we encountered sluggish, venomous Gila monsters. Tarantulas were common. Scorpions tried to camp in our blankets. By night sometimes Rosalio guarded the herd against marauding coyotes, mountain lions, and bears.

Three days out of Tonto Basin we entered Borego Canyon, a 200-foot-deep slash in a green-clad mountain. Scenting its isolated pools of water, the sheep scrambled into the gorge. "Baa! baa!" they bleated. Like the pipes of an organ, the canyon's red granite ribs gathered the sounds and tossed back echoes.

Amid this chorus, Rosalio detected a cry of distress.

"A sheep is stranded in the rocks," he said. "I go down."

I watched him, shoes in hand for sure-footedness, as he made a perilous descent down shelving, slippery rock to a ledge where a silly, self-trapped ewe stood dismayed by fear of an 11-foot jump. Not until Rosalio reached the ledge did the sheep make a panic-stricken leap for freedom.

Lessons in Herding

Amid the canyons Rosalio gave us a lesson in herding. I marveled at how well he kept track of all his charges as they spread out into three or four ravines. As Rosalio could not trust his dogs to round up all the strays, he had to scour each ravine, searching behind each bush and boulder. An uncanny ability to distinguish his animals' hoofprints from others helped this master tracker. In these badlands, nevertheless, he must have walked four times the distance covered by his sheep.

Scarcely a day passed that Rosalio did not maneuver scattered brigades half a dozen times to hold his army together. Like a field general, he marched his forces out of difficult places with subtle moves.

I never ceased to wonder that Rosalio and Pablo got along so well. Other herders got



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Kodachromes by Francis R. Line

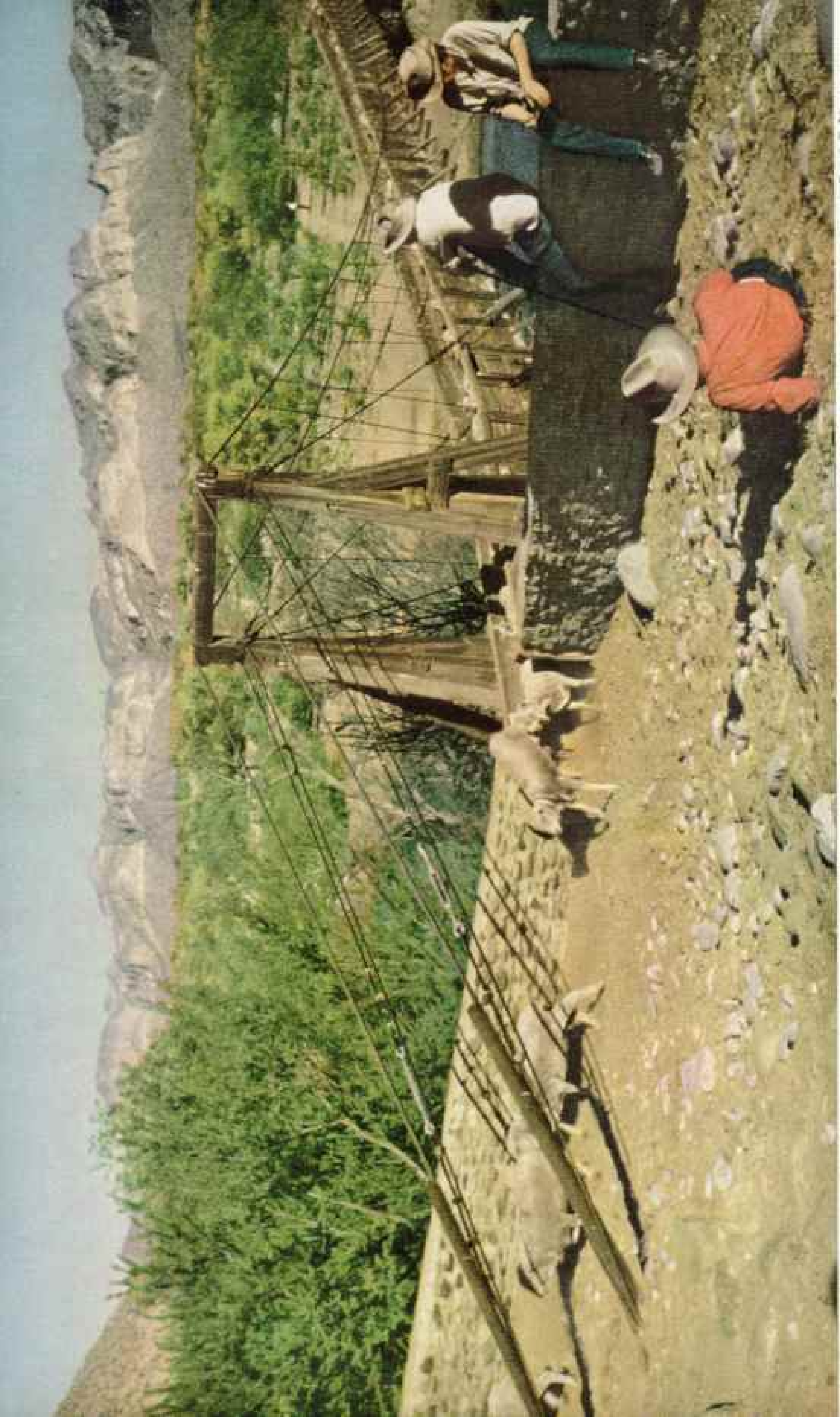
♣ Sheep, Marching Across Arizona, Block Roads, Stir Dust Clouds

Each spring the herd sets out from Salt River Valley to mountain pastures. Pablo Chavez (right), the cook, rides his burros bringing up the rear. Rosalio Lucero, the herder (left), walks the entire 52 days.

♣ Earning Their Salt by Desert Ordeal, the Sheep Collect a Payment

At Rock Tank the trail approaches a highway, enabling the herd's owner to deliver fresh supplies. Adrienne Line, meeting her photographer-father here, distributes the salt feast.





Sheep Express Joy at Quitting the Shaky Salt River Bridge by Taking Circuslike Leaps to Solid Ground

Hung from cables, the sheep bridge vibrates violently with each crossing. Formerly the flock had to swim the river, and many animals were lost.

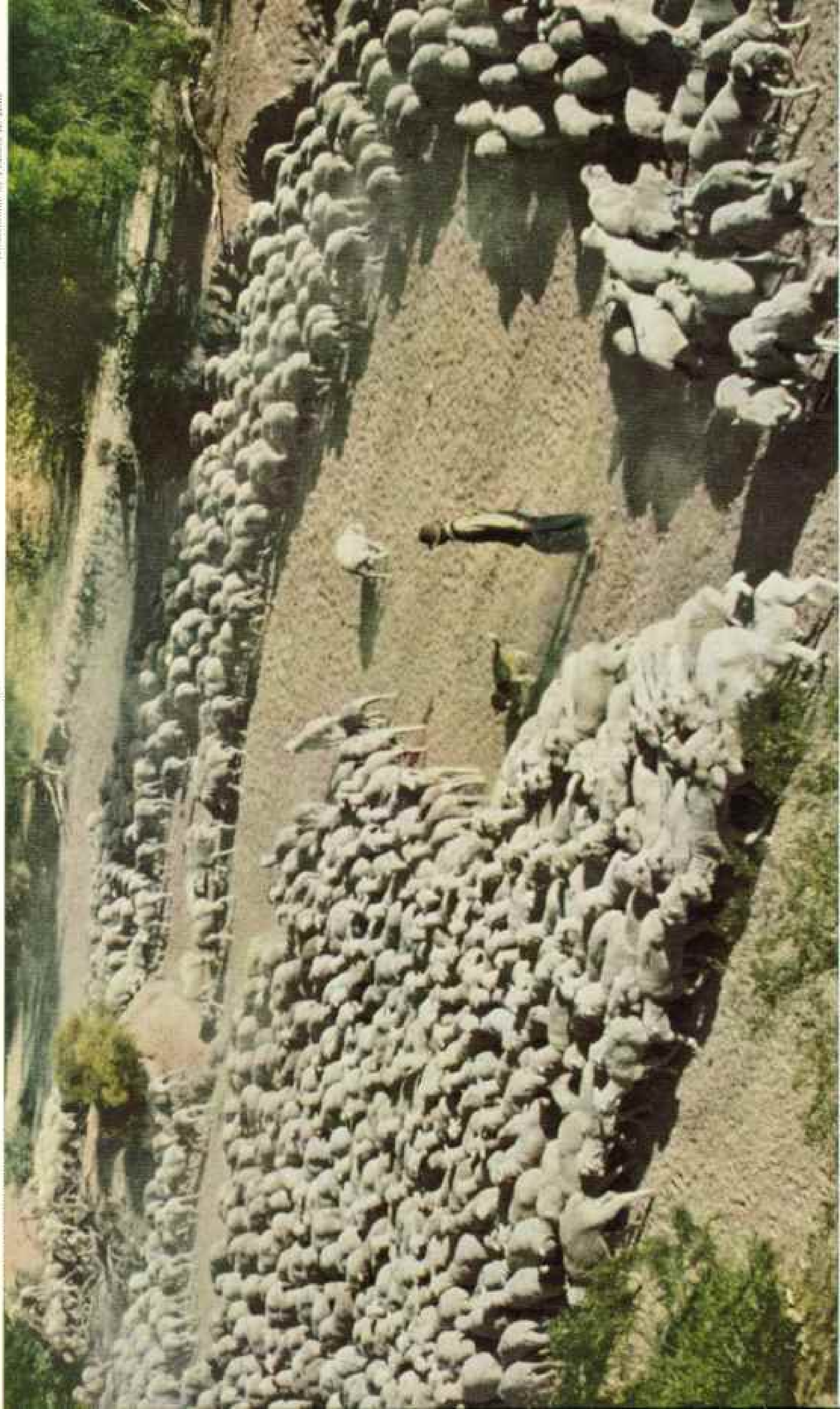
Plagued by Gnats, the Sheep Bunch Up, Heads Down, in a Dry Wash. Rosalio and a Dog Start Them Moving

No act of mercy is too onerous for the herder. While rounding up strays in rough country, Rosalio walks four miles to the herd's aid, but he never complains.

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Ketchikan to Ft. Francis B. Laine





The Desert Sizzles: Pablo Pitches Tent for Midday Halt, Four Times a Day He Packs or Unpacks the Burros

Casks are for water. The camp carry virtually all the belongings of the two men, who spend their lives in the open. They thrive on solitude and silence.

In the Stony Desert Pablo Shoes His Horse Weekly

© National Geographic Society



And Every Other Day He Bakes Pan-brown Biscuits

Continued from Page 46





Through Weird Cactus Pitfalls the Caravan Cautiously Threads Its Way

As impoverished and hostile as the desert seems, it glitters with inviting blooms. Cholla cactus (seen in blossom) attacks the sheep with spines (opposite page). Tall saguaros serve hawks as pin cushion lookout towers.



© National Geographic Society

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Exochordatus by Francis R. Line

★ Desert's Road to Life-giving Water Is Paved with Bruising Cobbles

Though sheep withstand days of thirst, other members of the trek must drink more often. Tonto Creek fills their kegs. Beyond lie the distant Sierra Ancha and nine lonely days with no sign of habitation.

✧ Rosalio Stops Beside a Barrel Cactus, Plucks Thorns from His Dog's Paw

Each night he burns off the cholla cactus lest the spines adhere to the herd and drive deep into the flesh. When grass is gone, sheep nibble cactus blooms, sometimes wounding themselves severely.





Hot and Dry, the Flock Drinks Sip by Sip in Tonto Creek

Arizona herds totaling almost 100,000 make two annual migrations across the desert. Each year the number diminishes.

Nature's stern necessity dictates their way of life. Summer's blazing heat drives them from Salt River Valley. Autumn's first snows chase them from alpine pastures.

In the desert the sheep do not have enough to eat, and long intervals separate drinks. Cactus thorns and flaming rocks lurk at every step. Pumas, bears, and coyotes lie in ambush. Rattlesnakes provide accidental hazards.

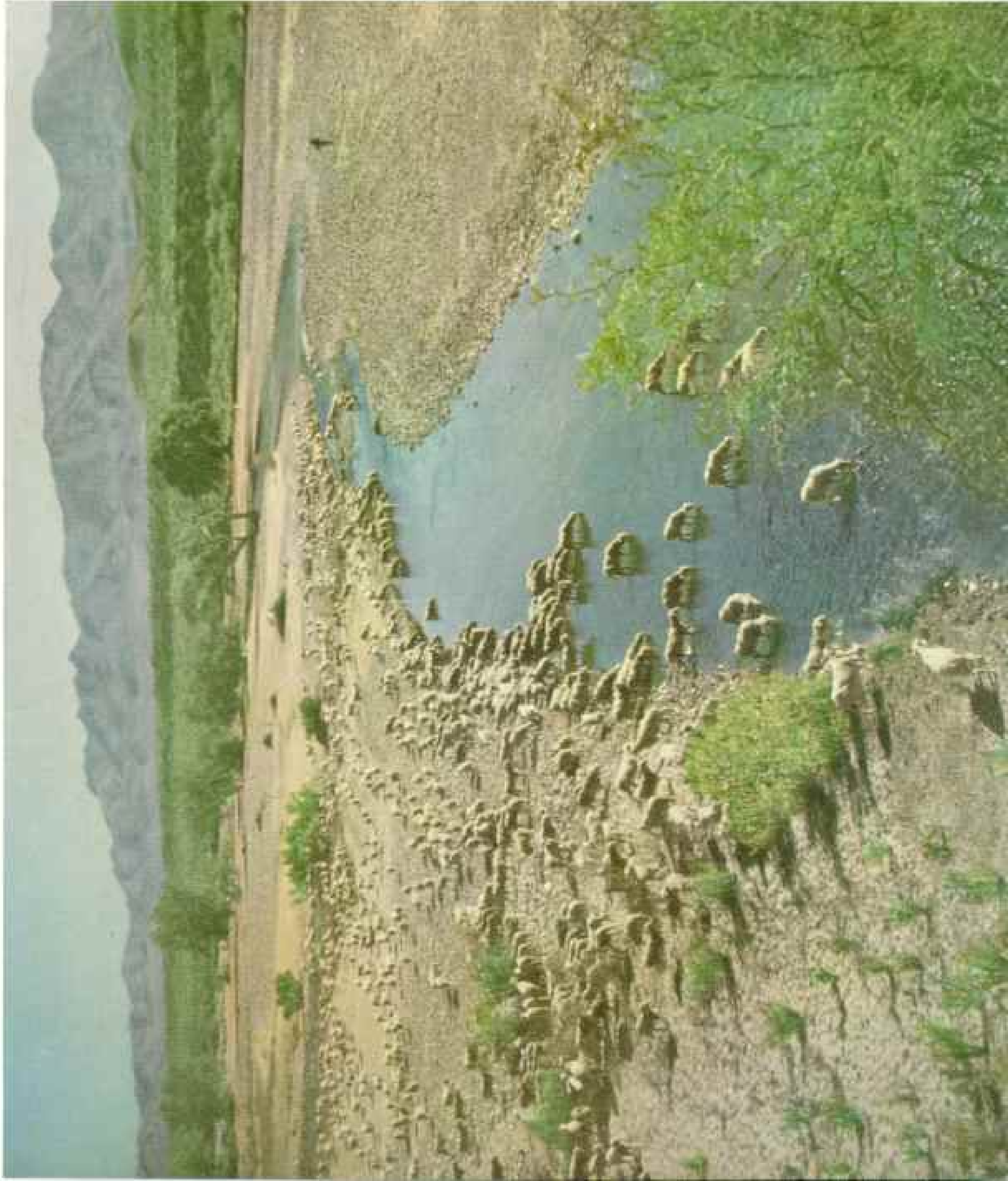
Through such perils Rosalia guided his 1,547 charges without losing one.

These animals are ewes. Their lambs, save for a few kept for breeding purposes, went to market before the trek began. Pampered rams make a roundabout journey by rail and truck to save their strength. They will meet the ewes in the White Mountains, where pastures are neck deep in grass.

In the fall the ewes, wool grown long again, will trek southwest to bear their lambs.

© National Geographic Society

Redrawn by Patricia R. Lane





Herder and Helper Form a Living Gate and, Like Insomniacs, Count the Sheep Leaping By

As a guard against losses, a census must be taken every few days. Rosalio, switch in hand, counts by twos; Pablo by hundreds. So swiftly does the herd race past at times that the author, good at counting imaginary sheep, got dizzy. This operation took nearly an hour.

Near Trail's End Dogs, Horses, and Sheep Cool Off in the High Forest's Shade. A Visitor Stirs the Stew

© National Geographic Society

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Photograph by Brenda H. Linn





© National Geographic Society

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Kodachrome by Fennell H. Line

♣ Pablo Quits the Comforts of Camp and Rides for Water

On a cold night the average American does not give much thought to the origin of his warm blankets. To supply the raw wool, men like Pablo endure hardships uncomplainingly.

✧ Rosalio Is as Devoted to His Dogs as They Are Faithful to Him

Virtually all his life has been spent on the trail. Over 60 years old, he learned his trade at 13 from his father. He helps the lame sheep, nurses the sick. The dogs he often waters from his hat.



on one another's nerves and quarreled, but never these two Spanish-Americans, who had worked as a team for years.

Rosalio's only obligation was to his sheep, but seldom was there a meal at which he did not peel Pablo's potatoes or dry his dishes. Just as often Pablo helped Rosalio in the herd's emergencies.

At last out of desert and canyons, we stood on the summit of the Sierra Ancha. There we entered a new world. Manzanita shrubs wove a tangled glory atop the plateau. "Little apples of gold," Rosalio called the manzanita, because it bore a tiny fruit. It was blossom time, and each plant held clusters of urn-shaped fairy bells.

Rosalio, ever the herder, was unimpressed. "Yes, pretty," he admitted. "The sheep eat it some, but not much. And it's too thick for them to get through."

We had paused to rest late one afternoon when the sky darkened and a shower set in. Pablo groped through the boxes for a Spanish almanac. For this day, May 9, he read the Arizona forecast: "Dry, with dusty winds."

Rain Proves Almanac a Liar

"Well, maybe she right," observed Pablo. "Maybe this rain blow over pretty quick."

Two hours of showers persuaded Pablo that the almanac could be wrong. Only then did he pitch our tent. It was barely large enough for our bedrolls.

As darkness settled, Pablo and I hauled in logs and built a campfire. Struck by raindrops, the embers hissed and swirls of tinted smoke billowed up.

We said "Buenos noches" early. The rain's tapping fingers beat a tattoo on our tent.

Morning was sodden and chilling, and the rain was heavier than ever. Rosalio could not afford to rest; his sheep needed fresh forage. Taking his slicker and staff, he set out into the dismal dawn. Dripping trees and driving rain swallowed herd and herder.

Pablo went out to hunt his hobbled burros, while I stayed in camp to tend the fire. A chilling gust of wind rattled the tent, and the rain changed to hail. White, icy stones bombarded the Dutch oven, hot over the fire, and burst into steam.

Pablo's burros doddered into camp. Never had they appeared happy, but now each animal was a document of woe. Like silent monuments they stood, water dripping from each ear as from a trough. A donkey's ears are his only glory; now these had gone to half-mast. When rain and hail seemed unendurable, men swore, dogs whined, and sheep bleated, but burros stood silent, dripping.

Drenched and muddy, Rosalio returned, knelt by the fire, and scraped clay off his shoes. Lunch was a soggy affair.

By now the dog George was so chilled that he was shaking violently. When we retired for rest, Pablo covered George with a pack blanket and tucked him beside his own body.

Presently the flood broke the dams and ditches we had built to protect the tent. Rosalio and I repaired them. Hailstones, bouncing like rubber balls, popped beneath the tent flaps and melted. So exhausted were Pablo and the dog that their sleep was never troubled.

No matter how miserable, the dog did not neglect his duty. Though Rosalio did not give his customary whistle on leaving camp that afternoon, George, shivering but faithful, took his place behind the man.

Town 50 Miles from a Railroad

Our last soggy slab of pan bread was gone. From the tent I watched Pablo, swathed in his black slicker, his hat dripping, mud clinging to his shoes, mix his dough in the rain and bake it in the Dutch oven.

That night the storm blew itself out. Trek resumed in the morning.

Now the trail carried us into Pleasant Valley, and here I left the herd and visited Young, a ranchers' community of two stores, one church, one school, and some 500 people.

It would be difficult to imagine a more isolated community. Young is 50 miles from a railroad or a doctor. At the time of my visit it was connected with the world by one shaky telephone line.

Cut off as they are from the services of electricians, plumbers, and other artisans, the citizens have made up for the loss by developing a community spirit. I found them pitching in with hammers, saws, and paintbrushes to build a new wing to their church. With similar enterprise they equipped a lending library.

Leaving the comforts of town life, I caught up with the herd.

Sheep Hurdle Awesome Barriers

In our path stood Ramer Canyon, a miles-wide gouge strewn with twisted pines, ravines, and ridges. In places the underbrush was so thick that we could not see a dozen sheep out of the herd. Most of the time Rosalio had to run to keep track of his charges.

Next, the Mogollon Rim, a severe escarpment, rose like an exaggerated copy of the Hudson Palisades. As I looked ahead, I wondered how the herd was going to surmount this long, tremendous barrier.

© Max Kneller from *Western Ways*

Sheep Stampede Across a Swaying Span

Stockmen believe Salt River bridge is the only one maintained anywhere exclusively for sheep. Suspended from cables, the narrow walk vibrates dizzily (page 459). It stands northeast of Mesa, Arizona.

Up to now Rosalio had seldom used his dogs; for dogs, he told me, chased the sheep and tired them. But at the Rim he put the goats in the lead and turned the dogs upon the herd. Reluctantly, the seething mass began scaling the tumbled terrain.

Above the bleating of timid ewes Rosalio detected the cry of a lamb in distress. Retracing his steps, he found the animal wedged between two rocks. These would have been its headstones if the herder had let weariness prevail over compassion.

Frequently I saw this patient man stooping to give first aid to the injured, searching out the lost, and carrying the weak across boulders. His first act on reaching the top of the Rim was to fashion his hat into a cup and pour a canteened drink for his dogs.

Once beyond the Rim, we found ourselves near Heber, summer headquarters of several Salt River herd owners. In their corals we held reunion with other newly arrived nomads.

It had been a tough season, and tales of hardship were many. We learned that one herder, lost in Ramer Canyon, had wandered five days in delirium until a deputy sheriff tracked him down.

Another, bitten by a rattlesnake while climbing a ledge, had walked and ridden unassisted to Heber. A cactus spine cost the eye of a sheepman. One herder lost 300 strays in a canyon, where they vanished as if by black magic.

Danger: Locoweed

One final danger faced the herd: locoweed lay in ambush. This poisonous herb, if eaten, damages the nervous system of livestock. Their eyes grow glazed; their gait slows down. Weakness and emaciation follow. By day our sheep did not touch the weed, but by night they nibbled it if forage became exhausted. Each day, therefore, Rosalio scouted the country ahead to find a campsite free of locoweed.

The trail swung into open plains in a great arc. We skirted Dry Lake and Snowflake and entered the Fort Apache Indian Reservation. Now we were at an elevation so lofty and cool that ice formed in our washbasin at night.

On June 3 we arrived at the home range, which lies in the White Mountains between McNary and Springerville.

For 52 days the sheep had marched on thin rations. Now they waded into grass neck deep; they drank from bubbling streams.

Here to welcome us and take the final tally was the herd owner. We started the trek



Sabu, a Wise Old Leader of the Herd, Thoughtfully Takes His Rest Sitting Down

Goats led Rosalio's herd into difficult areas where sheep refused to go except as followers. Together with a few black sheep, goats also served as markers. If one was missing, it indicated that a small band had wandered off. Sabu, a camp favorite, ate scrups which the dogs didn't get and drank water from washbasins.



Pablo's Melancholy Burros Drink Their Fill from Sycamore Creek

The burros required water every day, though in emergencies they could go three days without a drink.



An Arizona Hunter Pets His Favorite Bear Hound

Marshall Loveless, whom the photographer found in an isolated cabin near Tonto Basin, makes a living hunting bears and guiding sportsmen. In 1913, while on safari in Africa, he employed his Western skills by lassoing big game.

with 1,547 sheep; we finished it with 1,547. Rosalio, leaning on his crooked staff, did not comment when the owner announced the count, but his smile spoke volumes. No other herder could boast as good a record.

Rosalio Wears a Biblical Look

At that moment I was reminded of the twenty-third Psalm. For me, the trek had dramatized that song of David written so many centuries ago.*

"The Lord is my shepherd; I shall not want. He maketh me to lie down in green pastures: He leadeth me beside the still waters." These words evoked a picture of Rosalio's struggle to provide water and forage in the desert.

"He restoreth my soul." This sentence summarized the trail's solitude and grandeur and its spiritual effect on man.

"He leadeth me in the paths of righteousness for His name's sake. Yea, though I walk through the valley of the shadow of death, I will fear no evil: for Thou art with me." Only Rosalio's leadership had brought his charges through the shadow.

"Thy rod and Thy staff they comfort me." Rosalio with his crooked staff was the very picture of an Old Testament character.

"Thou preparest a table before me in the presence of mine enemies." I visioned Rosalio salting the sheep.

"Thou anointest my head with oil." Often I saw Rosalio salve wounded sheep with ointment.

"My cup runneth over." The cup was Rosalio's battered hat, holding water for his dogs.

"Surely goodness and mercy shall follow me all the days of my life: and I will dwell in the

house of the Lord forever." Peace and plenty at journey's end was the herd's reward for 52 exacting days.

Certainly sheep are unchanging symbols of man's trek across the world. If David could return, he would find definite parallels in the herder's way of life.†

* See "Among the Bethlehem Shepherds: A Visit to the Valley Which David Probably Recalled When He Wrote the Twenty-third Psalm," by John D. Whiting, NATIONAL GEOGRAPHIC MAGAZINE, December, 1926.

† For additional articles on Arizona and on sheep in the NATIONAL GEOGRAPHIC MAGAZINE, see "NATIONAL GEOGRAPHIC MAGAZINE Cumulative Index, 1899-1949," especially the following: "Seeing Our Spanish Southwest," June, 1940; "Arizona Comes of Age," January, 1929, both by Frederick Simpich; and "Indispensable Sheep," April, 1928.

Kew: The Commoners' Royal Garden

BY THOMAS GARNER JAMES

With Illustrations by National Geographic Photographer B. Anthony Stewart

A MEMBER of the London Natural History Society reported the reaction of a Kensington sparrow to one of World War II's first air raids.

It fainted.

Having seen for myself the solicitude which Britain bestows on its tenderest wards, I can appreciate the outrage of her Nature lovers when a Nazi bomb blew the glass out of Kew Gardens' Temperate House, exposing to an English winter several thousand specimens of plants never meant to suffer such rudeness.

While we walked together through the Gardens, Kew's Director, Sir Edward J. Salisbury, C.B.E., F.R.S., told me how Britain's wartime command had assured him priority for replacing the precious panes. Racing against both the war and the weather, the gardener-scientists saved 90 percent of the blast's victims.

Such stories illustrate what to me is the essential wonder of one of the world's great centers of research. The Royal Botanic Gardens at Kew, Commonwealth headquarters for plant study, clothe vast learning and vast economic importance in disarming garments of fragrance, color, bird music, and deep humanity.

Little Birds and Little Britons

Little birds and little Britons play delightfully around each other on Kew's green lawns beside unparalleled collections of plant exotics.

For an entrance fee of one penny, the visitor can see 45,000 different living species from every botanic beauty spot on the globe, and gain admittance to a university whose texts are flowers. No signs or permanent fencing tell him "Keep off." If all paths to learning were only as pleasant!

Nearly two million visitors pass through Kew's 288 acres of beauty annually. But even while they manifest a very personal pride in its loveliness, few of them realize how much they owe to the "green fingers" of the modest scientists working here. For Kew has given generations of Englishmen not only much pleasure and much instruction, but even their means of existence.

Almost unnoticed behind a garden hedge or a mellow brick wall are the seedbeds in which botany's "back room boys" have nurtured world-changing industries.

The bombs aimed at Kew's acres of glass recalled Axis campaigns to capture the cin-

chona and rubber plantations of the Far East. These great raw-material-producing industries, as do others in Europe's tropic colonies, hinge on Kew.

Kew in Lilac and Rhododendron Time

Come down to Kew in lilac, or any other time. It is less than 10 miles west of London's City.

Although to Londoners the weeks of lilac and bluebell blossoms are the most popular, Kew presents her natural-history lessons at all seasons. The peacock butterflies of autumn and its chrysanthemums are as gorgeous as spring's tulips and magnolias or summer's rhododendrons (pages 483, 488, 494, 496, 497).

In the woodlands laid out by George II's Queen Caroline, an extraordinary variety of birds live throughout the year, feasting on Kew's fruits in autumn and at all times on crumbs brought them by human friends.

A special committee of the Ministry of Works publishes an annual report on the birds seen in Kew and in other of the royal parks.

The enormous Herbarium at Kew is the most famed of all world institutions devoted to taxonomy—the identification and classification of plants (pages 481, 501).

In its tiers of shelves, 6,000,000 sheets of plant specimens are preserved and grouped by classes, orders, families, genera, species, and varieties. Eighteen divisions of the globe provide a geographic cross index to the collection, which is particularly rich in type specimens.

The figure of 6,000,000 is a rough estimate, based on counts of sample sections, for no one knows the exact number.

"If I put one man to work on it," Sir Edward said, "I estimate that it would take him at least 42 years, Sundays off, to examine all the specimens of plants we have preserved in this building."

The pressed and fumigated plants are supplemented by special collections preserved in alcohol, by water-color representations, and by fruits and seeds.

Recent research in Kew's Jodrell Laboratory has suggested a still more detailed method of classifying certain families and genera: by relationships revealed in microscopic study of sections cut from the specimens. Particularly useful in identifying timbers, this inves-



Subtropic Palms and Ferns in Jungle Profusion Soar under Glass of the Temperate House

After a wartime bombing raid, 16 cartloads of broken glass were removed from this greenhouse. Some potted plants hang in mid-air at balcony level to give others space to grow. Here one comes down for replacement.



Learned Members of the Royal Society Visit Kew's Herbarium

The Royal Society, founded three centuries ago, is Great Britain's most distinguished scientific organization. John Winthrop (1606-76), popular governor of Connecticut, was one of its original 119 Fellows. Here in the right foreground Sir Edward J. Salisbury (back to camera), Kew's Director and the Society's biological secretary, converses with Sir Charles Darwin (facing camera), grandson of the author of *Origin of Species* (page 500). Sir Robert Robinson, president of the Society, stands on the extreme right.

tigation is adding files of microscopic slides to Kew's range of identification aids (page 498).

On near-by shelves of the thrice-enlarged Herbarium building is an equally rich store of botanic books. Many of the more than 50,000 housed here are literally priceless.

With such sources in type specimens and descriptions available for matching or comparison, Kew's experts identify new plant arrivals without a "probable possible shadow of doubt, no possible doubt whatever" (p. 490).

Kew's master file of authentically named specimens is the standard of authority.

A Mecca of the Botanic World

And just as the flower beds and glasshouses are open to fellow gardeners, Kew's Herbarium files are open to trained taxonomists.

I realized how Kew is the mecca of the botanic world when I met here the dean of American taxonomists, Dr. E. D. Merrill, Director Emeritus of the Arnold Arboretum.

With practiced hands he pulled some of his twoscore-year-old specimens out of Kew's files and added: "My old herbarium in Manila's Botanical Gardens is now destroyed; but here at Kew, as in Washington, are duplicates."

The Herbarium's Keeper, Dr. W. B. Turrill, related to Merrill how some of the treasured files were moved into Oxford and Gloucestershire to spread the risk from incendiary raids.

The prodigious task of rearranging them again at Kew after hostilities ceased was completed in less than 12 months. No one smokes inside the Herbarium's locked doors; fire losses in the files could not be restored.

From Kew's uniquely rich source material gathered by generations of collectors, the taxonomists prepare the great guides and compendiums of plant names and relationships which are Britain's monumental contribution to botanic knowledge.

Since 1841, when Sir William Hooker became Director, the plates and text for the *Botanical Magazine* have been prepared at Kew. This is probably the oldest botanical periodical of its kind still in continuous publication, for it was launched in 1787 by William Curtis, noted botanist of the Chelsea Physic Garden.

A Heritage of Charles Darwin

Made possible through a gift of Charles Darwin, the *Index Kewensis*, listing the names of all seed-bearing plants and the place of their first publication mention, was prepared at Kew and published in 1895. Every five years since then a supplement has brought up to date the knowledge added to the Herbarium's files.

From Kew's never-dry well of information also have come the *Floras*, which aim to systematize the plant identification for Commonwealth and Empire areas. These are exhaustive dictionaries. The *Flora of Tropical Africa* alone requires ten volumes to synopsise (more may be added), with another two volumes for the *Flora of West Tropical Africa*, and seven more volumes for *Flora Capensis*, or the Cape area. A new *Flora* is now in preparation at Kew for British East Africa.

The magnificent goal of the *Floras*—"that anyone acquainted with the English language may, by these books, identify any plant found wild on Commonwealth soil"—is near to achievement. Britain itself, the West Indies, Hong Kong, Australia, New Zealand, former British India, Mauritius, and the Seychelles have now been covered, in addition to Africa.

As Salisbury summarizes, with emphasis: "No effective use can be made of work done on plants unless they can be accurately named."

Kew is their fingerprint file.

Most beautiful of all the treasures in Kew's Library are centuries-old flower paintings done by artists almost unknown outside this special field. Their accurate transfer to parchment of the colors and forms of flower specimens is a unique example of craftsmanship combining art with scientific training.

In the first rank of these botanical artists was Franz Andreas Bauer, an Austrian who settled at Kew in 1790 to paint flowers for George III. This plant-portrait master is buried in St. Anne's churchyard on Kew Green

side by side with masters of human portraiture, Johann Zoffany and Thomas Gainsborough. His brother Ferdinand was also a botanical artist (page 490).

If natural-color photography with permanent dyes could be perfected, botanists would have a new tool for plant identification, and the Herbarium's files, holding their mirror up to Nature, would doubtless include photographic plates and slides as well as the pressed specimens and water-color drawings.

Kew aims to assemble in one place the largest, most representative, and most efficiently indexed plant-identification material the world has yet seen.

Rolling Stones Out to Gather Moss

A special feature of Kew's Library is travel books, collected here because of their valuable references to plant ecology.

Trained to keep their eyes open, peripatetic botanists have been excellent travel reporters. Who has ever surpassed, for instance, the descriptive powers of John and William Bartram, father and son, the 18th-century Philadelphia gardeners who explored the fringes of the American Colonies? European writers from Wordsworth and Coleridge to Chateaubriand dipped deeply into William Bartram's *Travels* for their scenes of wonder.

John Bartram, as King's Botanist, was one of a number of New World explorers who sent seeds back to His Majesty's superintendent of Kew Gardens, John alone introducing probably 200 new plants to English cultivators. Some of Britain's best-known garden flowers of today descend from these 18th-century colonists in reverse who brought back to the mother country the image of Pennsylvania hills or southern savanna.

Gardener-statesman Thomas Jefferson visited Kew on his trip to Britain; and Kew remembers his Lewis and Clark Expedition in the plant genera named *Clarkia* and *Lewisia*.

Kew's English landscape style, described by a late director as "suave and ample," is the last rose of the Georgian summer. Kew remains in many respects as George III left it.

Sir William Chambers, Kew's royal architect, would be at home today with landmarks he began constructing in the middle 1700's: the 163-foot Pagoda (page 500), still without a crack in its ten stories; the little Greek temples scattered about the Gardens; and the superb classic Orangery.

The Queen's Cottage, which George III's consort Charlotte used as a summer teahouse, is intact, knee-deep in beds of bluebells beneath its dusky-yellow roof thatch.



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Rhododendrons by H. Anthony Howard

Beauty and Scientific Interest Vie for Attention in London's Botanic Wonderland

Kew Gardens, officially the Royal Botanic Gardens, occupy nearly 300 Thames-side acres. Here grow some 45,000 species of plants, including many exotic specimens. These Lord Palmerston hybrid rhododendrons originated at Kew.



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Illustration by H. Anthony Hunt

Century-old Palm House, a 60-foot-high Glass Masterpiece, Keeps Tropie Palms Alive in Raw London Winters. Bananas Ripen Perfectly

This mammoth greenhouse, 360 feet long, is the creation of Decimus Burton. It is an outstanding example of the Victorian era's pioneering in iron and glass.



← Rhododendron to Iris, Kew's "Children" Get Hand Care

On the left, the NATIONAL Geographic camera met *Rhododendron dichroanthum*, an old friend of The Society. The plant stems from one of some 300 rhododendrons collected in the early 1920's by plant explorer Joseph F. Rock as leader of The Society's expedition to southwest China. A complete set of these handsome shrubs was sent to Kew as a gift of The Society.

F. C. Coates (left) recalls having set out the original collection.

See April, 1925, NATIONAL Geographic: "The Land of the Yellow Lama," by Dr. Rock, and "The National Geographic Society's Yunnan Province Expedition," by Gilbert Grosvenor.

A Botanist's Hobby ➤

Assistant Curator C. P. Raffill, fifty years at Kew, has charge of the Temperate House. After official hours he retires to his quarters and works with his own flowers until darkness, which in the British summer may fall as late as 10 p. m.

Here Mr. Raffill pollinizes an iris in the hope of creating a new variety. Neat felt hat and stiff collar are standard items of his working uniform.

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Rhododendron by B. Arthur Stewart





Flowers of All Seasons Spend Their Brilliance in the Ever-sparkling Conservatory

Less-favored greenhouses work the year round to light up this glassy showcase for the few days or weeks of their specialties' glory. Succeeding displays keep the Conservatory always popular.



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Kodachromes by R. Anthony Stewart

✧ First with Pencil, Then with Needle, Embroidery Students Copy Nature

Kew is a favored spot for London artists. These young women from the Royal School of Needlework sketch the Gardens' beaths as patterns for their designs. They work near King William's Temple, a structure built in 1837, the year of William IV's death.

✧ An Apprentice Gardener Beds Tulips Among Dark Red Wallflowers

Kew conducts a training school for horticulturists. Hundreds of its graduates beautify estates the world over, some in the United States. These tulips are of the General de Wet variety. In the background, a weeping cherry stands near the Pond.



Pink Astilbe Charms an Amateur Botanist in the Rock Garden

More than a show place is Britain's national garden; it is a scientific institution, a botanic Berrillon file, serving world needs in the identification of plants. What Greenwich is to astronomy, the Gardens are to botany.

Since 1722 Kew's plant scouts have scoured the earth collecting valuable commercial species. A Kew explorer sailed with Captain Bligh on the *Botany* expedition of 1787, but did not survive the hardships of the captain's 3,600-mile open-boat voyage. His successor introduced the South Seas' breadfruit tree to the West Indies.

Other Kew explorers introduced South America's *Cinchona* (quinine) and *Hevea* (rubber) to cultivation in the Orient. Medicine and manufacture benefited enormously by the resultant savings and increased production.

Kew's Rock Garden, which fosters alpine plants, reproduces mountain scenery of the Temperate Zone.

This *Astilbe arendtii*, a Rhineland variety, originated in the Gardens. Astilbes form a small genus of the saxifrage family.

Astilbe's admirer humbly seeks to learn its secrets, but many a one, upon comparing her own garden to royal Kew's, does not hesitate to give the plant scientists a piece of advice.

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Reproduction by R. Anthony Stewart



What Could Be Finer than to Leave the City's Dreary Brick and Stroll Beneath the Climbing-rose Pergola?

When Kew was opened to public inspection in 1841, it attracted 9,000 visitors its first year. Now annual admissions number nearly 2,000,000. Six entrances and 15 miles of shady paths afford sight-seers so well that the Gardens seldom seem crowded. White roses are *Evangelines*; red ones are *Chaplin's Pink Climbers*.

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Kodakman for H. Arthur Murray





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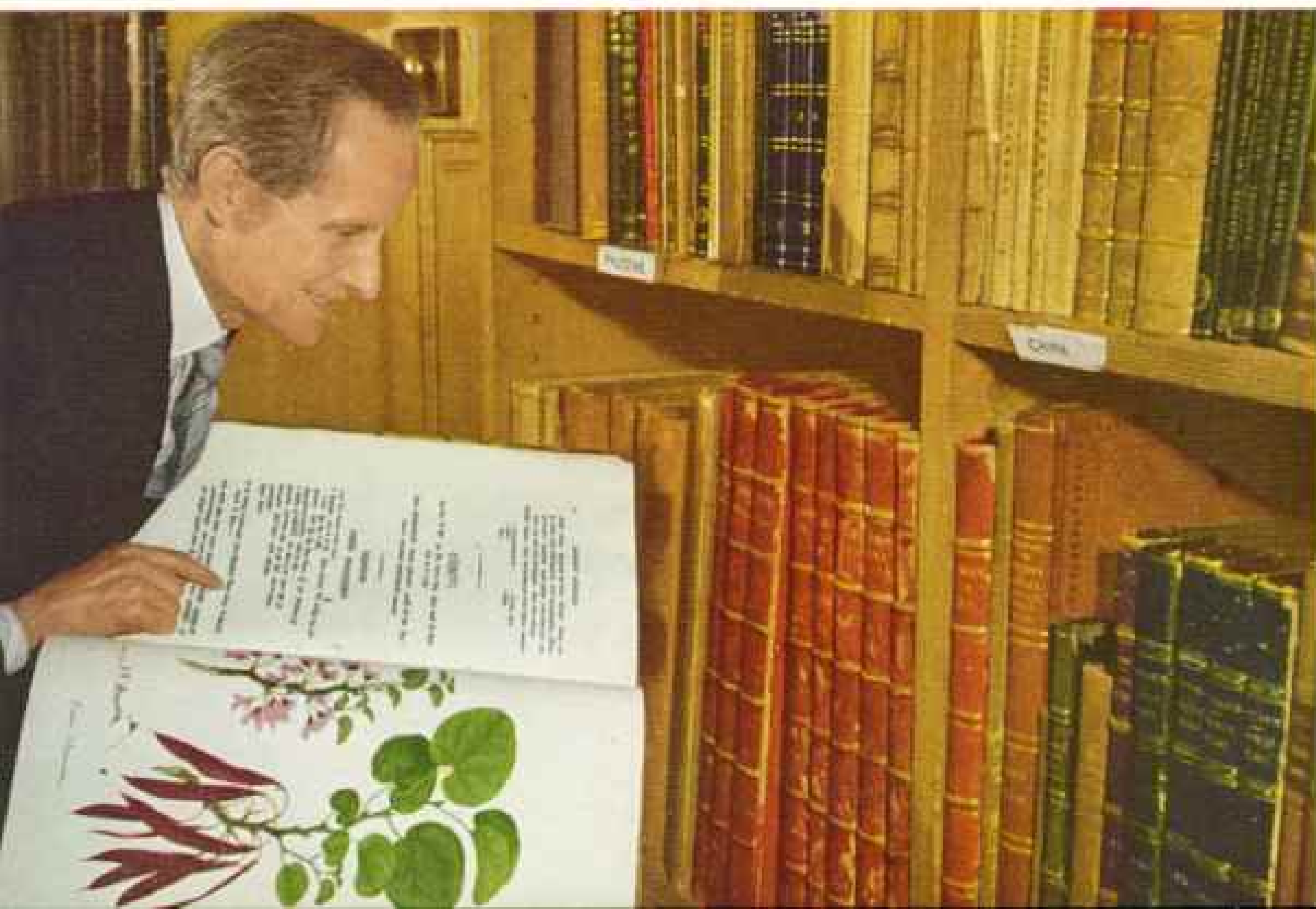
Illustrations by R. Anthony Stewart

^ Kew Students Inspect Types of *Coleus* as Part of Their Training Course

Lads at Kew work through the apprentice system from "boy" to "improver" before joining the "student" class drawn from budding gardeners throughout Britain. With Kew certificates they can get jobs anywhere. *Coleus* is a gaudy genus of the mint family.

ψ The Library Treasures 50,000 Books, Many of Them Priceless

Over the centuries Kew artists have pictured exquisitely and exactly many of the world's rare plants. Here Librarian H. S. Marshall opens one of the *Flora Graeca* illustrated in color by Ferdinand Lucas Bauer after a botanical expedition to Greece in 1784.





A Booted Botanist Hammers Home the Lesson, "Grow Your Own Greens?"

During the war and austerity years the directors set aside a demonstration area as a laboratory for victory gardeners. When Kew's young apprentices went into Britain's armed forces, girls took their places.



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Illustration by H. Arthur Stewart

The Fragrance of Geraniums Borne on Fountain Spray Perfumes a Balmy Sunday Morning at the Pond

Dense woods flank Museum No. 1, one of the Gardener's four show places devoted to economic botany. It houses the dicotyledons. Prominent among them are samples of mustard, tea, flax, peas, and valuable woods. Here are quinine bark, rubber, gutta-percha, potatoes, buckwheat, nutmeg, and avocado.

«*Rafflesia*'s Beauty Is Only Skin-deep—It's Truly a Stinker

This vegetable monster vies for the title of world's largest flower. In Malaysian jungles the bloom attains a width of 15 three feet and a weight of 15 pounds. The raised corona, nearly an inch thick, encloses a "nectary" capable of holding six quarts of liquid.

Rafflesia arnoldi, a parasite like the mistletoe, has shed roots, stem, and leaves as unnecessary to its lazy existence.

When seeds are ready for dispersal, the plant decays, exuding a carrionlike aroma attractive to swarms of flies. Nature intends that some unwary jungle beast shall step into this pulpy pitfall, pick up the sticky seeds, and scrape them off against a convenient vine or root. If the chosen foot-scraper is a *Cissus* vine, *Rafflesia*'s natural host, the tissues of root and parasite soon blend so thoroughly that the eye cannot tell them apart.

This artificial specimen flows in wax at Museum No. 3.

Smiles Bloom at Kew →

A. L. Richards illustrates the author's impression that "long service intensified the passion for plant study. It showed itself even in the photogenic faces of Kew's oldest 'students.'"

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Reproduction by B. Anthony Stewart





Hybrid Lupines, Bursting Like Jack-in-the-boxes from Kew's Soil, Imitate the Spectrum

As if purples and pinks were not enough, their varying shades stand out. Blossom differs from blossom; some change colors from stem to top. Texas' bluebonnet is one of the lupine tribe.



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Illustrations by R. Anthony Hunt

♣ A Rare Hybrid Is *Primula kewensis*, Creation of the Royal Gardens

This Kew primula, if encountered in Nature, might be ranked as a true species. At first the hybrid was sterile, but Kew's gardeners kept it alive by cuttings. In 1905 it produced seeds and thereafter bred true. Patricia Lewis holds the plant amid normal kindred.

♣ George III Combed the Globe for Plants; Bird-of-Paradise Honors His Queen

Strelitzia reginae is named for George's Queen Charlotte, Princess of Mecklenburg-Strelitz. A giant banana-like herb, the original *Strelitzia* was taken to Kew from Africa in the 1770's. Francis Masson, who gave his life to plant exploring, was the collector.





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Richardson III B. Anthony Bennett

When Slender Tulips Splash the Gardens with Color, London Knows It's Spring; the Broad Walk's Call Is Irresistible

Exotic trees bordering Kew's walks which imitations overseas. Here is Virginia's persimmon, there Kentucky's coffee tree. The Caucasus contributed this Zelkova; that oriental ginkgo was planted in 1762. A cedar of Lebanon, felled by storm, demobilised the Gardens' Temple of the Sun in 1916. Netherlands growers contributed these tulips as a "thank you" to the British people in memory of wartime comradeship.

Late in May a Feast of Color and Fragrance Greet Visitors to the Azulea Garden

Azuleas form a group of the rhododendrons. British gardeners have obtained beautiful results by crossing Asia Minor species with American.

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Illustrations by H. Arthur Hewart.





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Kodachrome by H. Anthony Stewart

★ A Kew Museum's Gums and Resins Resemble Candies in a Store Window

Forty centuries ago gum arabic collected from sick acacia trees went into Egyptian paints and cosmetics. Today vegetable gums go into paints, inks, pharmaceuticals, "frustrproof" concrete, and other products. Shellac, an insect excretion, is used in plastics and varnishes.

✧ Iris Petals Turn to Gold, Blue, Red, and Green in the Chemist's Beaker

A simple test to determine chemical pigments is made in Kew's Jodrell Laboratory by Dr. C. R. Metcalfe (left) for the sake of the camera. The laboratory's research into the anatomy of plants has thrown new light on their scientific classification.



Around it are the beech, chestnut, and oak woodlands where the birds sing.

Kew epitomizes even more than the history of English gardening. Outside London, few spots have seen so much of Britain's storied past as this riverside curve between Kew and Richmond Bridges.

Julius Caesar's columns may have forded the Thames here in 54 B. C. In Syon House, closing a vista across the river from Kew, Henry VIII imprisoned Catherine Howard; and from Syon House Lady Jane Grey was carried by barge down to the Tower of London to be for nine days a queen before she died on Mary's scaffold.

Where Queen Elizabeth Walked

From the near-by Palace of Richmond, Queen Elizabeth liked to walk along the river path by Kew to the lawn marked now by the hollowed stump of a giant elm which was most probably her contemporary.

The present "Dutch House," or Kew Palace, in Kew, with the date 1631 showing over the door, then belonged to the estate of Lord Henry Capel, which John Evelyn described as having the "choicest fruit of any plantation in England." Since they bordered his royal parents' residence at Richmond Lodge, Frederick, Prince of Wales, son of George II, obtained a lease of the grounds from the Capel family in 1730.

The remarkable woman who conceived of Kew as a place where botanically interesting plants would be grown for the sake of the plants was Princess Augusta, Frederick's consort and mother of George III. In 1759, the same year the British Museum opened, Augusta started her living collections here on about nine acres of what is now the northeast corner of the Gardens.

Augusta's scientific adviser was the third Earl of Bute, who majored in botany while minoring in the relatively less important subject of court politics. Her head gardener, William Aiton, had been trained in Chelsea's famed Physic Garden belonging to the Apothecaries' Society.

The Reverend Stephen Hales, a founder of experimental physiology, designed the flues in the tanbark-heated greenhouse whose location is marked now by a giant wisteria.

Sir William Chambers, her architect, summed up in 1763 the miracle such men had wrought in Augusta's little garden:

"The gardens of Kew are not very large. Nor is their situation by any means advantageous; as it is low, and commands no prospects. Originally the ground was one continued dead flat: the soil was in general

barren, and without either wood or water. With so many disadvantages it was not easy to produce anything even tolerable in gardening: but princely munificence, guided by a director, equally skilled in cultivating the earth, and in the politer arts, overcame all difficulties. What was once a Desert is now an Eden."

The impress made by Augusta and her son George III on Kew still shows.

Kew Green is almost pure Georgian in tone, from the grassy cricket pitch standing out against the backdrop of St. Anne's Church to the onetime homes of royalty which fringe the green like a sunflower's petals.

George III's seven sons made almost a cricket team in themselves, his 13 living children requiring all the houses around the green for shelter.

Summering at Kew, Their Majesties rose at 6; and at 8 a procession of royal dukes from the respective houses converged to pay filial respects. Once a week, George and Charlotte, "attended by the whole offspring in pairs," walked around the Gardens "admiring the works of Nature" and being admired in turn by the royal guests.

George III's Taste for Science

George III's taste for science made Kew—while still a private garden, albeit a royal one—a link which bound the tiny island of Britain to naturalists around the world.

Advised by Sir Joseph Banks (42 years a president of the Royal Society and circumnavigator of the globe on Captain Cook's first voyage*), His Majesty started similar botanic gardens in many of the colonies and sent out Kew-trained men to superintend them. Banks made Kew a depot for colonial interchange of plants.

And what sowers of seed!

There was the Scot Francis Masson, Kew's first plant collector, who explored South Africa and then the Atlantic islands through the French wars. He was taken prisoner twice by French privateers, and finally succumbed to a Canadian winter while still collecting! (Page 495.)

And gardener David Nelson, accompanying Cook on his third voyage, and in 1787 sailing on Captain Bligh's *Bounty* with the mission of introducing breadfruit from the South Seas into the West Indies. Nelson lasted 3,600 miles of the voyage in Bligh's loyal but overburdened little launch before he perished on Timor.

* See "The Columbus of the Pacific (Cook)," by J. R. Hildebrand, NATIONAL GEOGRAPHIC MAGAZINE, January, 1927.



Leafy Avenues Converge on the Pagoda

In 1761-2 architect Sir William Chambers built the Chinese-style Pagoda for Princess Augusta. Its ten stories, stretching 163 feet, remain today without a fracture. Tree-lined lanes make the octagonal building the focus of several charming vistas. Generations of work were required to produce this landscape effect (page 482).

Curator John Smith kept the plant collections alive through Kew's "winter of discontent" following George III's and Joseph Banks's deaths in 1820 until the gardens could be taken over by the nation in 1841.*

Such selfless scientists remain as type specimens in Britain's record.

Darwin's Confidant

Heroic in all ways was the son who succeeded his father as Director of Kew in 1865: Sir Joseph Dalton Hooker.

Here was truly a man of many parts, who began his scientific career at the age of 22 by sailing to the Antarctic with Sir James Clark Ross on the *Erebus* and *Terror* expedition. Christmas of 1842, while the two ships lay locked in the ice, Hooker sculpted a frozen Venus from an ice mound to help cheer his companions.

By 1848 he was a self-made authority on the high mountain "botanic islands" of Sikkim and eastern Nepal.† The maps and sketches he made of the Himalayan regions he surveyed a century ago were not surpassed for many years.

Charles Darwin, his lifelong friend, wrote Hooker in 1862: "For long years I have looked up to you as the man whose opinion I have valued more on any scientific subject than anyone else in the world."

Hooker's encyclopedic knowledge of plant geography was the trellis against which Darwin shaped his theory of the origin of species.

In 1877, at the invitation of the United States Geological and Geographical Survey of the Territories, Hooker studied and reported on the botany of the mountain regions of Colorado and Utah.

Portmanteau Greenhouses

One of the earlier Britons to receive the Order of Merit, he lived on to 94 years. At his own wish he was interred at Kew, not far from the Sikkim rhododendrons which he had introduced to

* See "Time and Tide on the Thames," by Frederick Simpich, NATIONAL GEOGRAPHIC MAGAZINE, February, 1939.

† See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Peerless Nepal—A Naturalist's Paradise," by S. Dillon Ripley, January, 1950; "Nepal, the Sequestered Kingdom," by Penelope Chetwode, March, 1935; "Aerial Conquest of Everest," by L. V. S. Blacker, August, 1933; and "Nepal: A Little-known Kingdom," by John Claude White, October, 1920.

the world here through his well-loved Gardens.*

I had remembered seeing in London's 17th-century Apothecaries' Hall a portrait of Nathaniel Bagshaw Ward; but I was not at all prepared for my first sight of a Ward contrivance which in Kew's hands has been of worldwide service to economic geography—the Wardian case.

The Wardian case is a traveling greenhouse about the size of a steamer trunk, in which plant seedlings have traversed the Seven Seas as snugly as if they were in a cradle (page 506).

Medical practitioner Ward (1791-1868) was, like most Englishmen, interested in the mysteries of Nature. In the summer of 1829 he had buried the chrysalis of a sphinx moth in a glass jar partly filled with soil and tightly covered with a metal lid. He wished to watch the emergence of the adult moth, but his question put to the sphinx drew a surprising answer.

He lost interest in the moth itself, because a fern sprouted from the soil and grew without attention or additional water for nearly four years—and might have grown still longer if the metal lid on the jar had not rusted through.

Ward had stumbled upon the perfect incubator for tender plants.

In 1842, a year after Victoria had given Kew to the nation, he published his findings *On the Growth of Plants in Closely Glazed Cases*.

Constant experiment had convinced him that he could fill a case with palms and ferns which would not require rewatering or any other care for up to half a century, and they would be relatively immune to outside temperature changes or noxious gases.

The moisture evaporated from the soil and



Chemical Warfare Is Still Legal on the Insect Front

Six million sheets of plant specimens, some virtually irreplaceable, are housed in the Herbarium (pages 479, 481). Bacteria and insects seem ever eager to return them to the compost heap. The dried plants are inspected regularly and fumigated when necessary.

plant would condense again on the inside of the airtight case and run back down the glass to the roots.

Both Hookers, father William and son Joseph, were quick to recognize the possibilities in such a disaster-proof "brief case" for plant ambassadors.

* Mr. F. C. Coates, of Kew's arboretum staff, set out seeds of some of the rhododendrons collected by Dr. Joseph F. Rock, leader of a National Geographic Society expedition to Yunnan Province, China (page 485). Dr. Rock's collection contained more varieties than had previously been known in America. The Society gave complete sets of these remarkable finds to Kew (see, in the NATIONAL GEOGRAPHIC MAGAZINE: "The National Geographic Society's Yunnan Province Expedition," by Gilbert Grosvenor, April, 1925).



Smoke Invades Kew's Bright Green Until Gardeners Wear the Sooty Badge of Miners

As London spreads out, the wintertime grime from its chimneys collects on trees in ever thicker quantities. Cedars survive the black "plague," but delicate conifers have had to move to Kent (page 506).

The story of Kew's transfer of the Pará rubber tree (*Hevea brasiliensis*) from its Amazon tropical rain forest home to the plantations of the Far East* is as fine an illustration as any of the teamwork of botanist and economist—and a good tribute to Wardian cases as modified by Kew.

Rubber to Malaya

Many plants produce milky latex, and there is even one rather rare Chinese tree at Kew which holds solid strands in its leaves (*Eucommia ulmoides*); but the most important of all natural rubber producers is the *Hevea*.

Kew had already introduced the quinine plant, cinchona, from the Andes into India;† so South America was an established hunting ground for Kew's collectors.

Accompanying the cinchona botanist Robert Cross in South American botanic exploration in the early 1870's was Henry Wickham, who sent drawings back to Kew of the leaves of the tree from which Brazilian workers drew

latex. Sir Joseph Hooker identified the tree as *Hevea* and, securing the cooperation of the India Office for the bold proposal of transferring the plant to the far side of the world, commissioned Wickham to collect seeds.

In a race reminiscent of Jules Verne—for the seed lost vitality in a few weeks—Wickham got 70,000 out of the jungle and on board a steamer bound for Liverpool.

Over 2,000 of the lot successfully germinated at Kew in the summer of 1876; and the first consignment of healthy seedlings packed in 38 Wardian cases went out to Ceylon as the baggage of a Kew gardener.

By the following year they were established also in Malaya and Java, the beginnings of an industrial crop which within two human generations was worth to Ceylon and the Far

* See "Our Most Versatile Vegetable Product (Rubber)," by J. R. Hildebrand, NATIONAL GEOGRAPHIC MAGAZINE, February, 1940.

† See "Quinine Hunters in Ecuador," by Froelich Rainey, NATIONAL GEOGRAPHIC MAGAZINE, March, 1946.



A Bulletin Board, Program of the Changing Seasons, Lists the Plants in Bloom

As flowers approach perfection, they get billing on the special-interest list at each of Kew's six gates. A map (right) shows visitors how to reach the Holly Walk, Rock Garden, Pagoda, and other attractions.

East more than \$500,000,000 annually. This rubber also made possible the automobile industry of the United States.

Another venture of strategic importance was an 1850 transplant from Kew of various specimens cunningly selected to grow in the volcanic ash of Ascension Island, an almost treeless way station on the route of Her Majesty's ships to the Cape. By 1865 the delighted Admiralty reported: "Through the spread of vegetation the water supply is excellent, and the garrison and the ships visiting the island are supplied with abundance of vegetables of various kinds." *

In thus literally remaking the green face of the earth, Kew has been blessed by Britain's geographic position as an island "halfway house" centered in the principal land hemisphere and linked to plantation areas by the cheapest of all forms of transport—the oceans.

In Kew's germinating trays and hardening-off frames plants being transferred get a good fresh start before taking to the road again.

What has been almost as important: Kew's gardeners and scientists have become acquainted with the plant at first hand and close range. By the time it resumes its journey, Kew is able to send along with the seedling helpful information on its cultivation needs.

Colonial horticulturists are brought to view Kew's plant experiments. Thus Kew maintains in its economic collections a great variety of sorghums, so that officers on leave in England from African agricultural departments may study in one central spot more experimental plant types than they would ever be able to see while on field service.

Pineapples, bananas, tung, new species of coffee, cocoa, and fiber plants have been established in new areas, and much improvement, identification, and other information work has

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Greens Grow for GPs on Solless Ascension," by W. Robert Moore, August, 1945; and "Ascension Island, an Engineering Victory," by Lt. Col. Frederick J. Clarke, May, 1944.



A Seed Banker Counts the Currency of Plant Life

Kew, following a world-wide exchange system, shares the prizes of its collecting expeditions with other botanic gardens. Seeds of *Metasequoia*, the "fossil" big tree recently discovered alive in southwest China, were parceled out to Kew in such fashion. Here John Pask, drawing on the Gardens' seed bank, makes up packets for distribution.

been done on plants producing drugs, camphor, and spices, oils, gums, fibers, food grains, papers, and timbers.

In East Africa a subsidiary industry is developing now in essential oils from peppermint, geranium, and lavender plants, species suggested and supplied with the help of Kew.

In World War II, Kew experimented with substitutes for Japanese agar and European elder pith, both needed in the war effort. Syrup was made from rose hips to supply Britain's babies with the vitamin C which they could no longer get in quantity from imported citrus fruit.

It seemed as if the plants were trying them-

selves to repay Britain for centuries of nurture and care.

Princess Augusta's aim, however, still directs Kew's scientific energies. Though economic returns are welcome, Kew studies plants for their botanic interest generally rather than for the hope of profit.

Rescuing a Dinosaur's Companion

I was fascinated at Kew by the story of *Metasequoia*, a tree rescued from the mists of antiquity, a living link with the age of dinosaurs.

Metasequoia is a working name temporarily identifying a genus which, until World War II, botanists had known only as a fossil. Coal seams had shown the imprint of its leaf pattern, and Kew's taxonomists had analyzed such evidence as part of their general study of plant ancestry. Like the dinosaur and pterodactyl, *Metasequoia* was assumed to be lost except as some of its genes survived in subsequent modifications.

But, lo, out of that Elysian field for botanic explorers, southwestern China, came rumors that *Metasequoia* still lived.

Merrill at Arnold (page 481) provided funds for a search and rescue party, and the seeds reaching him in 1948 were parceled out through the long-established exchange system to gardens like Kew. Here they have now grown into healthy young foot-high "pups," the darlings of British naturalists.

I watched distinguished members of Britain's Royal Society shake their heads in wonder at such living fossils.

And *Metasequoia* was rescued in the nick of time! For Merrill told me that perhaps

fewer than a thousand trees of it were left in China, and these were disappearing steadily in the timber-eating civil war.

Now, however, *Meta-sequoia* can begin again. If Kew's seedling pups, distributed to Commonwealth experiment stations, should develop into good timber specimens, it would be another botanic miracle sprouting from Kew and from the world-wide network of cooperating scientists and gardeners which Kew has helped cultivate.

"Improvers" Are Aptly Named

Though Kew is essentially a research institution, an important part of its activity is the training of students. This takes many forms. I followed one party of school children along Kew's 15 miles of pathways while they identified exotic birds.

I watched another school group scattering along the beds of Kew's herbaceous ground where common varieties are set out in botanically related rows like Linnaean illustrations for a taxonomy text. Near by, girls from the Royal School of Needlework were making sketches for flower embroidery (page 487).

Director Sir William Hooker undertook what was considered then to be a most hazardous experiment when he opened Kew daily to the public in 1841. When he also opened the world's first museum to demonstrate the economic uses of plants in 1848, year of the Communist Manifesto, could anyone have foreseen that a century later British workmen would queue up to study such displays as the pollens most favored by honeybees?

The formal students of Kew are the young men who work up through its apprentice system from "boy" to "improver" (a felicitous name for a garden apprentice!) and "student"



Seedlings in a Cold Frame Suggest Chicks in an Incubator

Here baby plants in tagged pots are being transplanted from the protection of the glass-covered frames to greenhouses and the Rock Garden (page 488).

until they graduate with the prized "Kew certificate," the equivalent of a passport to gardeners' jobs anywhere (pages 487, 490).

For a long time the Royal Family retained the privilege of nominating two Hanoverians to be student gardeners at Kew. Until war interrupted, Kew exchanged student gardeners with New York.

One of the students I met in training at Kew had returned to his flowers from six-and-a-half years of service in tanks.

Both photographer Stewart and I were struck with the way long service at Kew intensified rather than diminished the passion for plant study.

Assistant Curator C. P. Raffill, 50 years at Kew, goes "home" at teatime to his own garden within Kew's encircling wall and there



Kew Packs a Wardian Case, Plant Life's Traveling Greenhouse, for Shipment Overseas

This wood and glass brief case for plant ambassadors is named for Nathaniel B. Ward, a 19th-century medical practitioner. While watching a moth chrysalis in a sealed glass jar, he was surprised to see a fern sprout and grow. Sealed in by the glass, it survived for years on its original moisture content. Kew quickly adopted and modified Ward's discovery (page 501). Clove, coffee, rubber, cocoa, pineapple, and other plants going into this case are drawn from Kew's economic houses.

works at new iris varieties until the summer night closes in on him at 10 p. m. (page 485).

Following London's blitz, Director Salisbury seized the opportunity to study at first hand distribution patterns and botanic competition among weeds springing from bomb-plowed City earth hared to seeds, sun, and rain for the first time in seven centuries.

Here in London is the largest human community the world has ever seen; as many as 7,000 persons to the square mile for a thousand square miles around St. Paul's.

On London's edge is Kew, a spot of bright green breaking through urban fog, a garden cast in a royal mold but now accessible to more commoners than any other garden ever.

Kew's once-inimitable collection of conifers can no longer stand up to London's ever-closer crowding. Smoke and dust have so caked on their evergreen leaves that, to save

the collection, new specimens have now been shifted to a more remote area in Kent (p. 502).

A heavy London fog will strip the leaves of begonias, deflower orchids, and give Kew's "boys" one of the world's biggest window-washing jobs.

But there are compensations in the urban setting. The same British century which gave the world the commercial revolution also gave it her landscape school, one of England's greatest contributions to art.

Every 18th-century shipmaster looking for a port of London cargo was also an explorer and collector, scanning the world to bring back a facet of Nature Britain hadn't yet seen. The thrusting energy which built London also built royal Kew, its saving grace.

Growing up together, London and Kew have kept royalty very human and given humanity something very royal.

Voices of the Night

An Explorer with Microphone and Flashlight Finds in Jungle and Roadside Ponds Unexpected Beauty and Interest

BY ARTHUR A. ALLEN

Professor of Ornithology at Cornell University

With Illustrations from Photographs by the Author

"THERE is some strange animal that sneaks through the jungle and watches us at work," said Dr. Eyring. "We hear the twigs snapping as it approaches, but it never comes close enough for us to see it."

"Each morning, when we are setting up our instruments, and again off and on during the day we hear it; but we have no idea how large it is. Perhaps it is a jaguar, perhaps only a curious native; but it gives us an eerie feeling to know we are being watched. Possibly you and Dr. Kellogg can identify and record it."

This was exactly the sort of problem that had brought us the invitation to join the Office of Scientific Research and Development project on jungle acoustics, and had taken us to Panama on the first leg of an expedition bound for the South Seas.

The engineers and physicists under Dr. Carl F. Eyring were assigned the job of measuring what happens to sound under all sorts of jungle conditions, and Dr. Paul Kellogg, associate professor of ornithology at Cornell, my son David, and I were responsible for recording and identifying the natural sounds that emanate from the jungle.

Here was our first challenge. For several weeks we had been recording the songs and calls of birds by day and the squeals and whistles and groans of all kinds of animals at night. Recording bird voices was an old story to us, for we had been doing it in the States for years;* but to sneak through the jungle at night with a flashlight and a microphone was a different experience.

We had come to appreciate how our boys in New Guinea felt when they were encamped in the jungle and had to listen to the strange sounds which, for aught they knew, were emanating from Japs as often as from animals. Their experiences gave birth to the OSRD project upon which we were engaged.

The next day found us near Madden Field, in Panama, in response to Dr. Eyring's suggestion, where the engineers had cleared a long, narrow strip through the jungle and set up their instruments at either end. Kellogg and I scoured the area for animal signs and then sat down to listen.

In half an hour twigs began to crackle, and we could well have imagined an enemy sneaking up on us. I had taken my stand against a tree close to a tiny clearing and then, as the crackling sounds grew louder, I could see a small black-and-orange bird flitting from the side of one sapling to another close to the ground across the open space.

Sounds of a Courtship Dance

What Dr. Eyring had heard was the courtship dance of Gould's manakin. The twig-snapping sound was made with the bird's swollen wing quills rubbing against each other as it flitted from one small tree to the next. This curious performance is described in Frank M. Chapman's book, *Life in an Air Castle*.

Not all of the jungle sounds were so easily identified. Some of the small birds, such as the green shrike vireos, that sang loudly from the lofty canopy of the jungle, though well recorded, remained unidentified for weeks. Some of the night sounds remain unknown to us even today, because we were unable to catch the insects that perpetrated them.

Many of the more satisfactory sounds were made by the tailless amphibians—i.e., frogs, toads, and tree frogs (page 514). They were satisfactory in that they could be tracked down with a flashlight, and the creatures didn't mind continuing their concerts in the beam of the light until they were captured.†

Even so, there were many surprises, such as the "cave frogs," which sang from little burrows in the mud at the edge of a pond and could not be found even when the flashlight was only inches from them.

One narrow-mouthed toad (*Engystomops pustulosus*) sounded like a large animal in distress; but when we found him calling by a little pool in the jungle, he was scarcely an inch long and round as a marble.

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Touring for Birds with Microphone and Color Cameras," June, 1944, and "Hunting with a Microphone the Voices of Vanishing Birds," June, 1937, both by Dr. Allen.

† See "A Frog That Eats Bats and Snakes (Smoky Jungle Frog)," by Kenneth W. Vinton, NATIONAL GEOGRAPHIC MAGAZINE, May, 1938.



David Allen

Puffed with Song, a Common Toad Sits for a Pondsides Portrait by the Author

Dr. Allen, beaming a hand light on *Bufo americanus*, crouches ready to flash a color picture. Few frogs or toads were this obliging; often they exhibited a prima donna's temperament. Most difficult to photograph was the big but timid bullfrog (page 521). In the accompanying story Dr. Allen describes his adventures hunting night wildlife with microphone and camera in tropical jungle and temperate marshes.

A Swainson's toucan resembled a squeaky wheelbarrow; a Panama ant thrush whistled distinct messages; a Giraud's oriole could have been a small boy learning to whistle.

A really terrifying sound was the call of the black howling monkeys. When a treeful of them suddenly sounded off directly overhead, I almost felt the teeth of a jaguar in the back of my neck.

After the war we returned home with recordings of some 200 bird, mammal, frog, and insect voices; so we felt impelled to include other animals as well as the birds and to set up at Cornell University what we believe

to be the first "Library of Natural Sounds."

An unusual opportunity came from the National Geographic Society in the spring of 1947 to record songsters of our Southern States. Unprecedented rains had turned most of Georgia into a frog pond, and as the deluge continued it made early-morning recording of bird voices impossible.

By nightfall the showers abated, and this was the signal for the frogs. Out they came by the dozen, by the hundred, by the thousand—peeping, chirping, trilling, barking, braying, and booming.

Accustomed though I was to the springtime

racket of peepers and toads in northern ponds and to the summer chorus of green frogs and bullfrogs from the lake shores, I was unprepared for the enormity of this southern chorus.

The different species had not awaited the coming of their appointed times as they do in the North, where water temperatures determine which species will perform. The warm April cloudbursts had brought them all out at once, and the effect was indescribable.

Returning from a lecture at Collegeboro, we heard what we thought to be a flock of lost sheep well within the city. There, in a puddle, was an amazing aggregation of animals, which in the headlights of the car looked like a vast collection of ping-pong balls that momentarily appeared and disappeared.

The bleating chorus continued in the flare of the lights, and we soon discovered that the ping-pong balls were the snow-white inflated throats of a host of spadefoot toads (*Scaphiopus holbrookii*). Each inflation lasted only a second or two, during which time the toad emitted a loud blast.

Spadefoot toads are burrowing creatures that spend the day beneath sandy soil and come out at night to feed. Irregularly and only after very heavy rains, all the toads in one locality will go hopping to one temporary pond, where the males start the bleating chorus so the females will know where they are expected to lay their eggs.

The eggs are laid in irregular strings and hatch within two days into tadpoles. Within two weeks and before the puddle has time to dry up, these transform into baby toads.

Spadefoots occur locally throughout the Southern States and as far north as Massachusetts; but their activities are unpredictable, since they breed any time, depending on the rains, between March and September.

We spent an interesting week in the vicinity of Collegeboro, with Dr. Malvina Trussell, professor of biology at Georgia Teachers College, serving as guide. This precaution proved desirable, for whenever we heard an unfamiliar sound we would get out our flashlights and start across fields and fences to find the pond where the creature was singing. On the way back we sometimes found the landowner barring our return with a shotgun.

After locating and identifying the musician, we would drag the microphone, pre-amplifier, and cable to the spot. While Dr. Kellogg in the car adjusted the amplification and the cutting needle, I would hold the microphone within a foot or so of the singer.

After securing a good record of his voice, I would then catch him to make certain of our identification by daylight with the aid of

Wright and Wright's frog book (page 513). This was imperative, for many of these creatures are chameleonlike in their color changes. One familiar with their appearance by day might easily confuse them at night.

Some Frogs Grow Paler When Singing

Many species of frogs are much paler when singing. The green tree frog (*Hyla cinerea*) becomes a golden yellow; the dark brown peeper (*Hyla crucifer*) appears a light tan; and the almost black bullfrog (*Rana catesbeiana*) may look like a blob of bronze putty as he lies inflated on the surface of the pool (pages 517, 518, and 521).

The brilliant green barking frog (*Hyla gratiosa*) usually changes to a deep, fuscous brown when he gets ready to sing. During the day he may display a few gold specks on a bright-green background or small, brown doughnut-shaped spots; or he may become entirely olive brown, though not approaching his nocturnal shade (pages 511, 519).

In addition to the vocal sacs which are so conspicuous a part of the performance, the whole body is inflated during the song, so that a normally slender frog may appear almost spherical (page 514).

My first introduction to the squirrel tree frog (*Hyla squirella*) was at night near Gainesville, Florida. Attracted by a duck-like quacking, I waded along the edge of a pond with my flashlight swinging in the direction of the sound. Finally the beam reflected from a large grayish-white bubble, behind which was an almost circular brownish body about an inch in diameter (page 517).

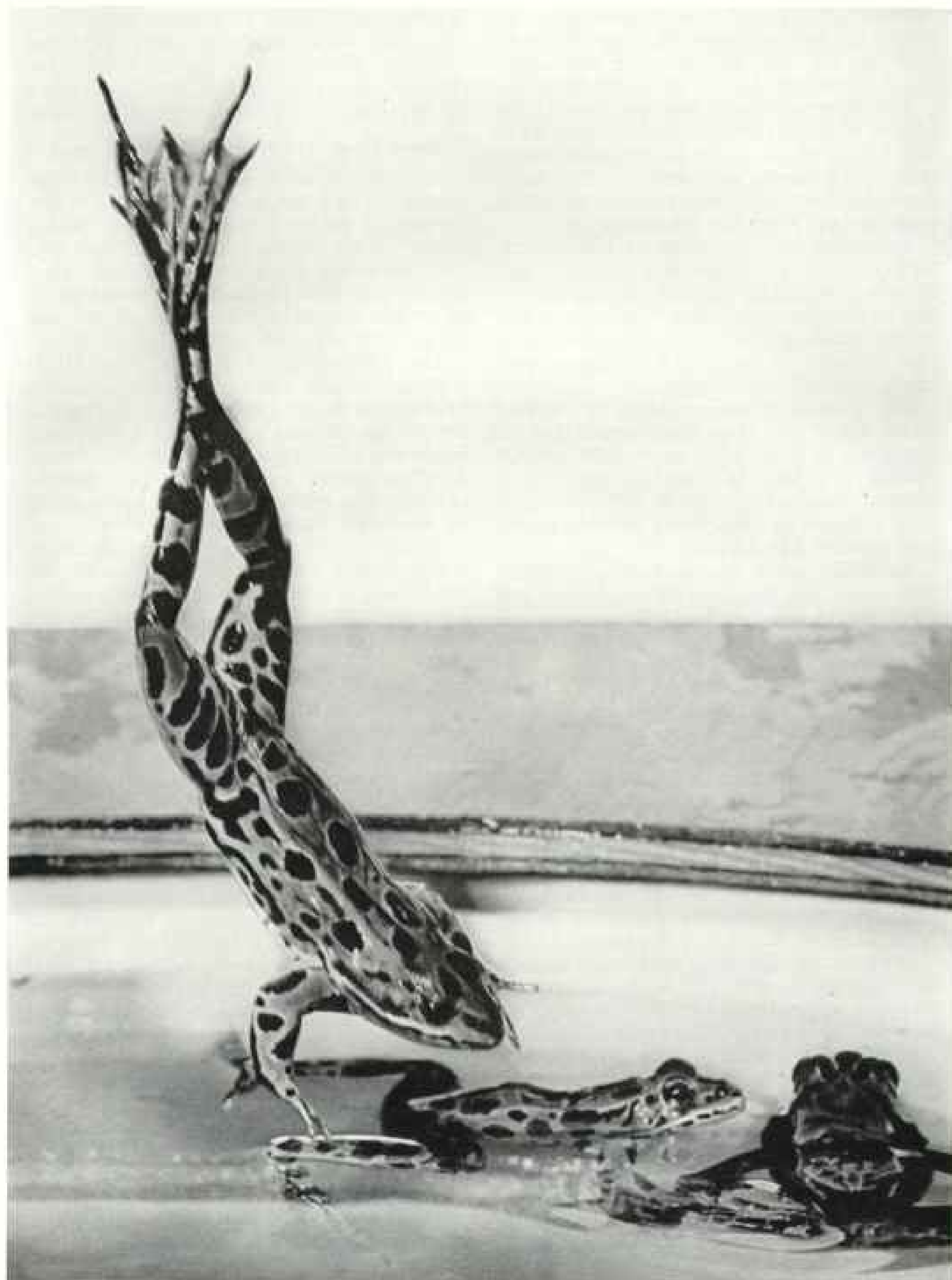
The next morning the jar in which I had put the curious apparition contained a beautifully slender, brilliant green tree frog, so different from the one I had captured the night before that I could hardly believe my eyes.

This tree frog derives its name from its habit of climbing into trees after the breeding season, where at the approach of rain a number of them often call in chorus. Then they sound more like barking gray squirrels than like quacking ducks.

A similar chorus of the bird-voiced tree frog (*Hyla avivoca*, page 518) may start off like a distant pileated woodpecker; but as other individuals join in, the sound travels through the southern forest in great waves, ebbing and flowing and confusing the listener as to its identity and whereabouts.

Such a chorus we recorded on Indian Island, Georgia, without seeing the musicians or knowing where they were hiding.

Many tree frogs have special places where they spend the day, though they may travel



Arthur A. Allen

"Move Over, Fellows!" High-speed Photography Catches a Meadow Frog in Mid-air

Only a few inches above water the frog is nicely streamlined, about to slip in with no splash. His eyes are retracted, the lids closing. Forelimbs are moving back to his sides. Valvular nostrils, still open, will be closed when his nose hits. Diver and floaters are all Leopard, or Meadow, Frogs (page 522). Taken at $1/5000$ of a second.



Arthur A. Allen

A Barking Frog Adds His Volume to Cornell University's "Library of Natural Sounds"

With microphone and pre-amplifier, Dr. Paul Kellogg records the deep voice of *Hyla gratiosa* (pages 509, 519). After the "interview" he will catch the creature for identification. Drs. Allen and Kellogg made some 200 similar recordings in the Tropics as a wartime Government project in jungle acoustics. Later they set up the University's unusual "library" (page 508).

considerably at night in search of insect food.

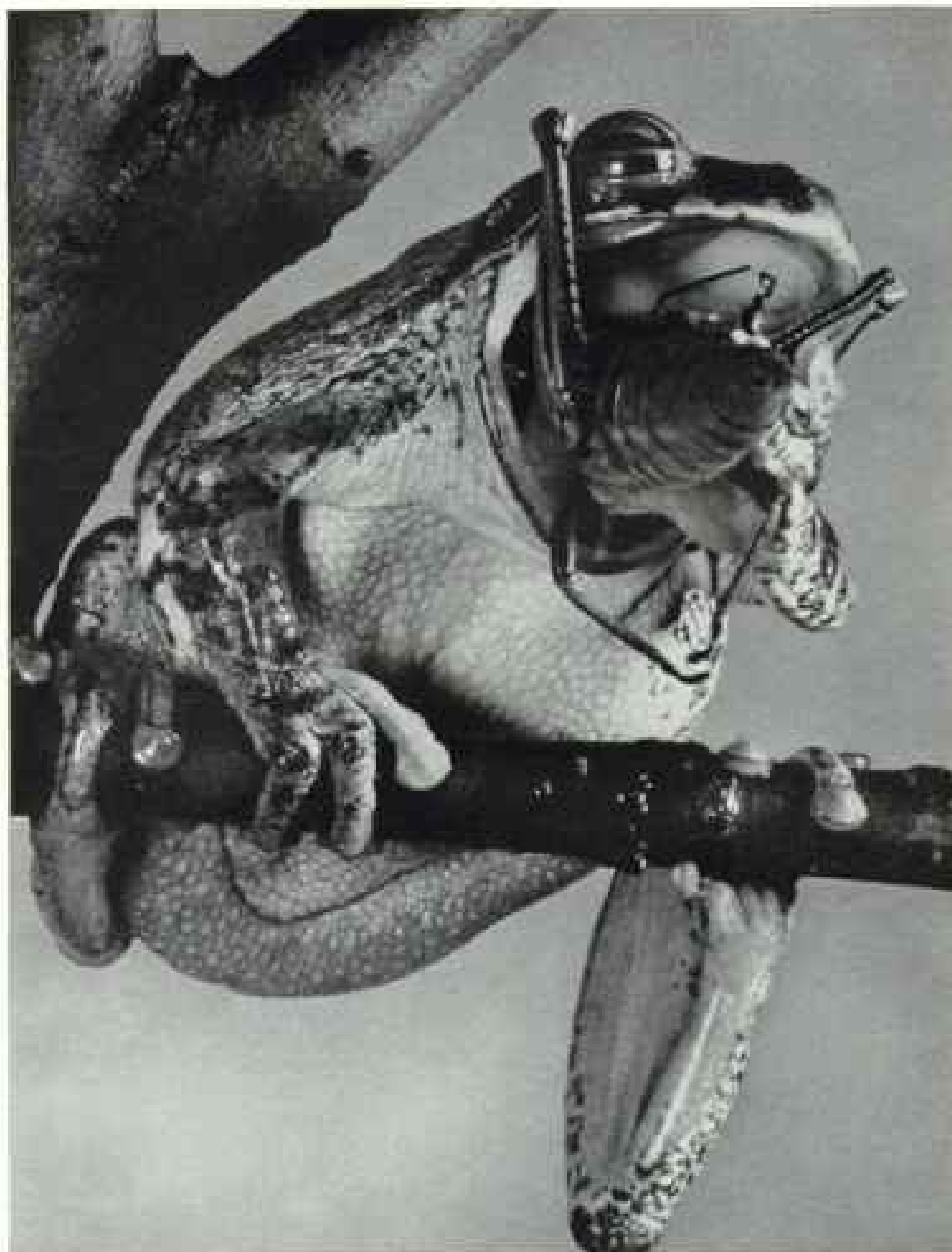
Prof. C. J. Goin, of the University of Florida, a leading herpetologist, showed me a squirrel tree frog on the under side of a holly leaf in his garden (page 517). He said it had been spending the days there for more than a fortnight, but left the tree at night.

Oak Toad Marked Like Tapestry

Common toads that hop along the garden path in the evening in search of beetles regularly return to the same little depression beneath a leaf or beside a stone that serves them as a home during the day.

One of the strangest calls of the whole amphibian fraternity is that of the oak toad (*Bufo quercicus*), a common resident of the Southern States as far north as North Carolina. It is less than an inch long, and during the day might be confused with a young common toad, or hoptoad (*Bufo americanus*), except for the needle-point red markings on its back that give the effect of tapestry (p. 516).

Our introduction to it was amusing, for we could think only of a flock of baby chicks calling out of the black night, when they should have been safely under their mother's wing. Tracking down the sound, we came



Robert C. Hermes

Spread-leg Hopper Sticks in a Mexican Tree Frog's Claw

Perched on a limb, the frog uses his free hand to cram the grasshopper down. It took him several hours to swallow it. Frogs snap quickly at moving objects, gulp their prey alive and whole. Sometimes, as above, they get a surprise. *Hyla bandinii* is found from southern Texas to Central America. Its call is a low "keck" followed by a chuckle.

upon one of the "babies" sitting in a shallow puddle in the piney woods, with a relatively enormous sausagelike vocal sac protruding from his throat to far above his head.

The chicklike peeping call was so out of proportion to the size of the music box and so different from other amphibian sounds that at first we thought something must have punctured the little creature's sounding board. Dozens of others, however, sang exactly the same way.

While we were recording this oak toad, there were several other species singing near by, and we rejoiced to have a quiet spot where few cars passed. But we had scarcely set up

on another species before a long line of cars went by, heading for a dull glow down the back road. Soon the juke box was going, and we realized we had selected the environs of a roadhouse for our evening's work.

On our way north from this Georgia expedition, we stopped one night near Pinehurst, North Carolina, when we heard a curious nasal quacking from a wooded hillside. Following it, we discovered a weedy pond at the edge of the woods where there were eight or ten bright-green tree frogs giving voice to the chorus we had heard from the road.

Occasionally a barred owl added his call to the ensemble—a great improvement on the motorcars and airplanes that so often ruin otherwise attractive recordings. I thought we were recording the green tree frog (page 518), although there was a certain double beat to the measure that seemed unfamiliar.

In the beam of the flashlight I did not notice the lavender stripe below the white line on the side of the frog.

Not until three days later, when showing the specimen to a frog-loving friend, was our attention called to the stripe, and we realized that we had recorded the much rarer Anderson's tree frog (*Hyla andersonii*), the very one we had at the time journeyed out to the New Jersey pine barrens hoping to find.

The Anderson is found from New Jersey to North Carolina. Associated with it is another amphibian, the carpenter frog, or sphagnum frog (*Rana virgatipes*, page 522). Its hammering call is heard in similar places, but its distribution continues southward into Georgia.

The carpenter frog has an amazing vocal sac. It swings up on either side of the head,

giving the strange appearance of a frog with water wings.

A still more human touch rewarded us in New Jersey when we recorded the pickerel frog (*Rana palustris*, page 522). This species is not unusual in appearance, but when it calls it reverberates like that sleeping neighbor in a Pullman.

Toads Exude a Milky Poison

We might just as well have recorded this frog's snores at home or in any cool pond east of the Rocky Mountains. It resembles a small brown meadow frog, but it is yellow under the legs. Its skin secretes a substance that is poisonous to other frogs, so that they cannot be kept together in close confinement.

Toads also, when annoyed, exude a milky substance from the glandular swellings on their skins. Dogs and other enemies usually leave them alone, although snakes are not so particular. These truly beneficial little animals are supposed to produce warts on the fingers of children who handle them. How this tale originated no one seems to know. One should be careful, however, not to rub one's eyes after handling toads, for even a trace of the secretion will cause eyes to smart.

By the end of the summer we had recorded satisfactorily the calls of 26 of the frogs, toads, and tree frogs of eastern United States, and felt ready to publish an album of records devoted entirely to the tailless amphibia as a companion volume to that of the American bird songs.

We had been so intent on making sure of our identifications that we had captured the actual frog whose voice we had recorded, and this had precluded taking action photographs of them singing. The photographic record, therefore, had to wait for another spring.

Years ago it had been my privilege to assist Dr. and Mrs. Albert Hazen Wright in flash-lighting these interesting creatures for some of the illustrations in their *Handbook of Frogs and Toads of the United States and Canada*, a third and greatly enlarged edition of which has recently come out. That was in the days of flash powder and slow black-and-white film.

Now, with flash bulbs and color film, the results are more satisfying, although the procedure is much the same. One locates his quarry as we did for the recording.

Most species are not very timid when singing, and if one works rapidly, he may be able to get focused and flash the bulb while the air sac is still inflated. More often, however, one focuses on the deflated frog or toad and then waits in the dark for him to call again before flashing the bulb.

It is a help to have an associate to hold the light on the frog while focusing. Sometimes the frog jumps forward when he calls, just enough to be out of focus on the processed film. Or perhaps his air sac may be so large as to extend out of the plane of focus, though the frog himself be perfectly sharp.

Perhaps, too, the creature will refuse to sing as long as the camera is pointed at him. This happens often on moonlight nights, when the frog can perhaps see the camera and mistake it for a night heron.

Stalking the Bullfrog

The bullfrog (*Rana catesbeiana*) is probably the best known of all the tailless amphibians, both for its sonorous voice and for the epicurean delicacy of its hind legs (page 521); yet it gave me more trouble than any of the others. Time and again I tried to stalk one—in Florida, Georgia, North Carolina, New Jersey, and in New York; but every one was so timid that it would not permit approach.

Finally, in a beaver pond near Ithaca, New York, we discovered that with a canoe we could get within photographic range (five feet) of the thundering amphibian.

These particular bullfrogs were calling from the open water of the beaver pond, where beds of water plants came nearly to the surface. Their large eyes glowed in the beam of the flashlight, so that they were easy to find.

When only their heads protruded, they showed green with yellow throats, and their bodies were very dark. This indicated that they were not ready to sing, for the preamble to song is to inflate the body, which causes it to float on the surface. It then changes from nearly black to a dull, putty color.

If alarmed when floating, this frog gives a sudden synchronous grunt and jump, which automatically deflates it so that the jump ends in a dive something like the old swimming hole "belly flop."

These exasperating performers sang so infrequently, however, that it was impossible to hold the canoe and tripod in exactly the same place for one to five minutes between calls.

Finally we found a fairly friendly frog in about two feet of water, where I could sit in the canoe while my wife and son, Glen, held it steady. Then, without disturbing the crooner, I could set the tripod in the water where the distance from the lens to the subject would not change even if the canoe drifted.

The principal difficulty with this setup was that the camera was so close to the water that there was not sufficient angle to show off the vocal sacs to advantage.

The eyes of frogs protrude like the head-

lights of a car, but when touched they are immediately retracted. I wondered if this protective measure might be of use to them when diving, but they traveled so fast that my eye could not discern what happened.

Therefore, with the aid of several Cornell students, I attempted a series of photographs of frogs jumping, using the speed flash at $1/5000$ of a second.*

We had difficulty getting the frogs to jump in the plane of focus, but eventually secured a few satisfactory snaps of the ordinary garden variety of jump, where the eyes are kept open and the arms and legs left extended in normal pose. We also snapped the high dive, in which the frog closes his eyelids, shuts his nostrils, folds his arms back against his body in a very streamlined manner, and hits the water with his nose (page 510).

Sometimes a frog attempted to jump so high that he lost his momentum before completing the jump. Then, instead of landing front feet first or all four feet together, the hind legs dropped, and during the fraction of a second when the flash made the picture he appeared to be dancing on his hind toes.

There are some 2,000 species of tailless amphibians in the world, belonging to 14 families. The largest number of species occur in the New World Tropics, but eight families and 99 species and subspecies have been described from the United States and Canada.†

The three familiar groups in the United States and Canada are the frogs, the toads, and the tree frogs or tree toads, as some of them are called. There are a number of structural differences separating these three families, but, in general, frogs have smooth, moist skins and toads dry, warty skins.

Tree Frogs Equipped with Suction Pads

Tree frogs resemble the frogs in their moist skins, but they have suction pads on their fingers and toes, which enable them to cling to vertical surfaces. Indeed, the southern green tree frog is known to jump from near-by vegetation onto lighted windowpanes for insects attracted there by the light (page 518).

Most of these amphibians are more active at night than during the day, though during the height of the breeding season many species call irregularly all day. Indeed, peepers (*Hyla crucifer*), cricket frogs (*Acris gryllus*), and swamp crickets (*Pseudacris nigrita*) when undisturbed sing nearly as continuously by day as by night. They are much less timid and much more easily observed, however, with a flashlight at night.

North American frogs and toads vary in size from the female bullfrogs, whose bodies may

be 10 inches long and may weigh $3\frac{1}{2}$ pounds, to the pygmy swamp cricket, or little chorus frog (*Pseudacris ocularis*), the males of which are the smallest vertebrate animals in North America, scarcely one-half inch long even when grown (page 521).

Most of these little creatures are insectivorous, but bullfrogs have been known to catch birds, to eat other frogs, and even to swallow snakes and alligators longer than themselves.

In most species the females are larger than the males, owing perhaps to the large number of eggs they carry. They are not equipped with the vocal sacs of the males and are usually silent. Some, like the common toads, have a limited variety of chirping notes apparently to help in sex recognition.

Many male tailless amphibia have secondary sexual characteristics, such as the swollen thumbs of the meadow frogs or the enlarged eardrum of the male green frog (page 520). Male bullfrogs and green frogs have yellow throats, while those of the females are white; and the vocal sacs of toads and tree toads, when not dilated, register darker areas than the corresponding parts of the females.

The vocal sacs are inflated through a narrow slit or two slits in the floor of the mouth. They serve only as sounding boards, to give resonance to the calls produced by the air driven back and forth from the lungs to the mouth past rather simple vocal cords.

If the little animal sings with its throat only partly inflated, which seldom happens, the sound produced has a different quality. When singing or croaking the frog's mouth is kept tightly closed.

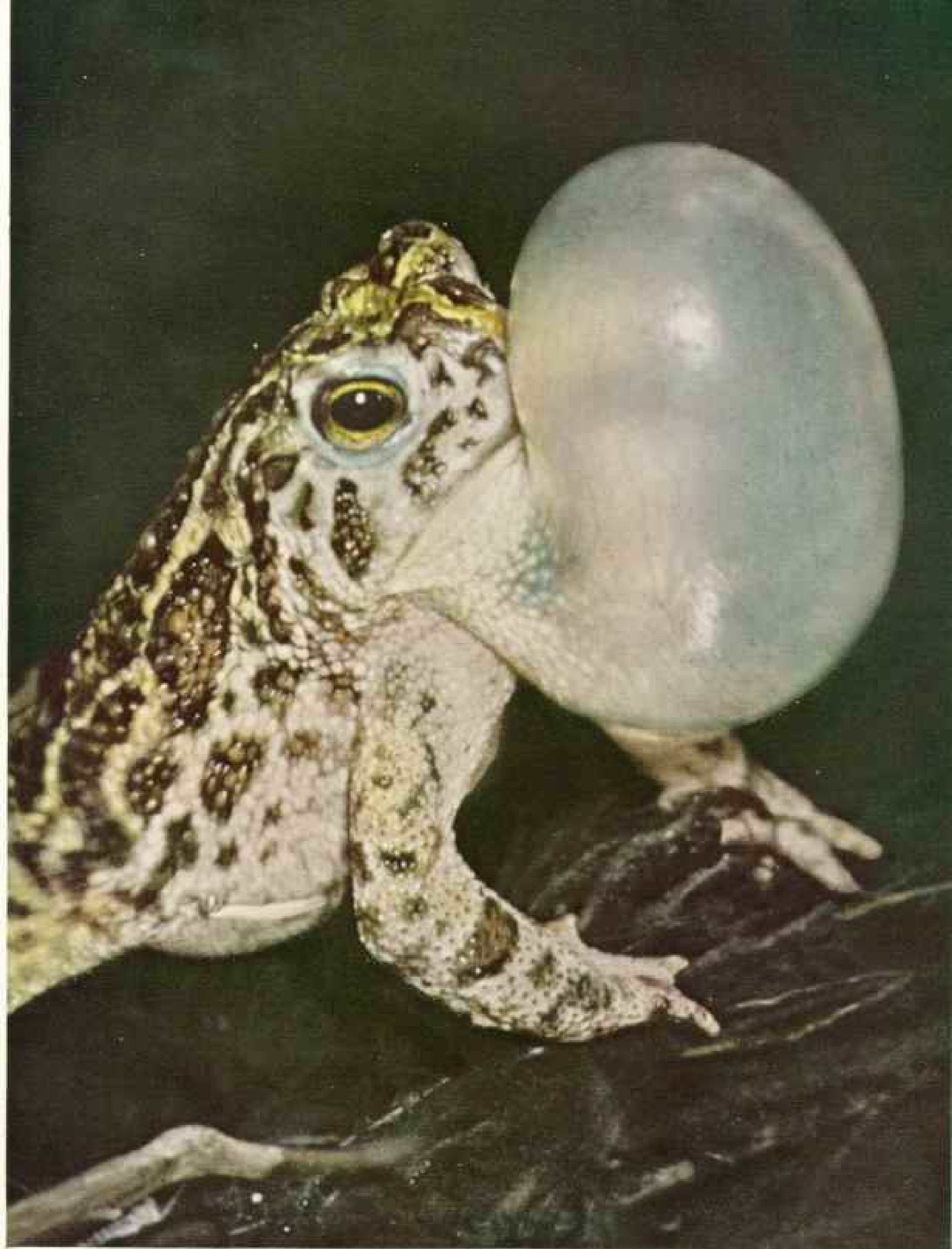
Only under the stress of great fear, as when captured by a snake, is the mouth opened, and then the resulting cry is a scream different from the normal call.

People are becoming much more sound-conscious, and many of us are distressed to hear western meadowlarks singing in movies purported to have been made in New York State, or California wren tits singing near Lake Champlain.

Perhaps someday we shall be just as particular about our night sounds. We shall not have frogs croaking with their mouths open, or western toads singing east of the Mississippi. Indeed, I visualize the time when the majority of us will drive along the road on a spring night and recognize the authors of songs that rise from roadside ponds as readily as the voices of radio crooners.

* See "A New Light Dawns on Bird Photography," by Dr. Allen, NATIONAL GEOGRAPHIC, June, 1948.

† See "Our Friend the Frog," by Doris M. Cochran, NATIONAL GEOGRAPHIC MAGAZINE, May, 1932.



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Kodachrome by Arthur A. Allen

Mate-calling, Big Western Toad Balloons His Vocal Sac and Blows a Minute-long Blast

The klaxonlike call can be heard on a warm, still evening over half a mile across the Great Plains. A chorus of the harsh, low-pitched trills may reach twice as far. Almost deafened, the author dubbed this species (*Bufo cognatus*) "the boiler factory toad." Air driven back and forth between lungs and closed mouth twangs his vocal cords. The sac acts like a sounding board. Only male toads and frogs trill; females are usually silent.



Toads Whistle Like Birds, Peep Like Chicks, or Trill Softly

Fully grown, the pygmy Oak Toad (*Bufo quercicus*, upper) is often less than an inch long. Despite a giant vocal sac, his call is a piping, birdlike whistle. Three or four together often sound like a brood of chicks. A native of our southeast pine barrens, Oak Toad has a fine-grained skin resembling tapestry or needle point.

The Common Toad, or familiar garden Hoptoad (*Bufo americanus*, middle), is found all over eastern North America. By day he hides under porches, stones, or logs. Night or rainy weather keeps him hopping for beetles and worms. The male's spring mating call is a prolonged trilling whistle.

Like *americanus*, the Canadian Toad (*Bufo hemiophrys*, below) swells his lower throat in song, but doesn't balloon it as much as the Oak and Western Toads. The result is a soft, sweet trill. Living chiefly in marshes in the Prairie Provinces, he dives into water for protection like a frog. Here, calling to a mate, he stirs up bubbles in a shallow pond.



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Illustrations by Arthur A. Allen





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Kodachrome by Arthur A. Allen

♣ Camouflage Protects a Singing Tree Toad; Spring Peeper Trills Unabashed on a Pencil

Lichenlike markings of the Common Tree Toad (*Hyla versicolor*) suggest a piece of bark. His call is louder and more distinct than the Common Toad's. A familiar springtime sound in eastern North America is the din of a chorus of Peepers (*Hyla crucifer*) in full voice. Volume of these tailless amphibians is out of all proportion to their size.

♣ The Small Southern Tree Frog Climbs and "Barks" Like a Gray Squirrel

Mate-calling at night by a roadside pond (right), he puffs himself into a brown ball and sounds like a duck. By day he appears slender and green. After the mating season he takes to the trees and makes squirrel-like noises. Scientists call him *Hyla squirella*; laymen, the Squirrel Tree Frog. One at left returned to his holly-leaf home daily.





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Kodachrome by Arthur A. Allen

The South's Common Green Tree Frog Poses as Hunter, Philosopher, and Troubadour A Candid Shot Catches the Seldom-seen Bird-voiced Tree Frog (Lower Left)

Like a face at the window, Green Tree Frog (*Hyla cinerea*) prowls a pane in upper left hunting for insects attracted by the light. Big toe and finger suction pads, common to all tree frogs, give him sure footing. Resting by day (upper right), he takes the world as it comes. Turned golden, at night, he sits on a lily pad serenading his ladylove with cowbell-like notes. His call is one of the South's most characteristic Nature sounds. A single Bird-voiced Tree Frog (*Hyla avivoca*) sounds like a distant pileated woodpecker. A chorus ebbs and flows in great waves, confusing the listener as to identity and location. Living chiefly in tupelo and cypress swamps from Georgia to Louisiana, *avivoca* is hard to find.



Unlike the Leopard Barking Tree Frog Can Change His Spots

Noted for his chameleonlike color changes, *Hyla gratiosa* seldom looks the same twice. He can vary the shade of his background color and even make the spots disappear.

The two upper pictures were taken in daylight of the same frog at different times. The one below was flashed at night in a pond, when *gratiosa*, unlike most amphibians, turns darker. Body and throat are about half inflated.

Reaching nearly three inches in length, the Barking Tree Frog is our largest native tree frog. A larger species has been introduced into southern Florida from Cuba.

Generally rare, *gratiosa* is heavily built, with a short, broad head. Large suction discs make him an adept climber. His skin, coarsely granulated on the upper body, has a secretion that gives a strong, persistent odor.

Frequenting high pines in the Southern States from North Carolina to Louisiana, he has a deep, hollow call that sounds like someone pounding on an empty hoghead. At times it resembles barking.

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Kodachromes by Arthur A. Allen

♂ A Croaking Green Frog Carries On, Uninterrupted by Photography

His "kerplunk" call suggests a banjo twanging. *Rana clamitans* looks like a small Bullfrog (opposite page). Less timid, he lives in ponds and pools from the Mississippi Valley to the Atlantic and southern Canada to Florida. Males average two to four inches long.

♀ A Flash in the Night Catches the Female Staring Wide-eyed at an Intruder

Her throat lacks the yellow luster of her mate's; her eardrum, near the eye, is smaller. But female frogs and toads usually average larger than males, probably because of the number of eggs they carry. Like Bullfrogs, Green Frogs are almost entirely aquatic.





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Illustrations by Arthur A. Allen

♣ Like David Before Goliath, a Puny Swamp Cricket Frog Faces a Giant Bullfrog

One is the smallest vertebrate, the other the largest frog in North America. Bullfrogs may reach 10 inches, weigh over three pounds. Pygmy Swamp Cricket Frogs (inset) seldom exceed $\frac{1}{2}$ inch. Their cricketlike chirps are heard around ponds from North Carolina to Florida.

♣ "Jug o' Rum!" Body and Throat Inflated, a Bullfrog Twangs His Bass Fiddle

Croaking, he changes from dark green to light bronze. Pouch under chin is his vocal sac. Bullfrogs (*Rana catesbeiana*) eat anything they can catch—insects, small fish and snakes, other frogs, even birds. In turn, they are hunted for their own tasty hind legs.





Some Aquatic Frogs Wear Gaudy Swim Suits and "Water Wings"

Instead of under-the-chin vocal sacs, these frogs have lateral pouches between eardrum and arm. Blown up in song, the sacs look like old-fashioned water wings or football shoulder pads.

The call of the Pickerel Frog (*Rana palustris*, top) sounds like snoring. Croaks resembling distant hammer blows give the Carpenter Frog (*Rana virgatipes*, center) his common name. The spectacular Leopard, or Meadow, Frog (*Rana pipiens*, below) gives a long, low croak followed by a few shorter notes.

Pickerel is found from the central plains to the Atlantic, from the Gulf States to Hudson Bay. Leopard lives all over North America east of the Pacific Coast States. Both have big, over-all body spots. Carpenter, found from New Jersey to Georgia, is more modest in subdued stripes. But an all-night chorus of Carpenters will keep unaccustomed lake-side vacationists awake for hours. Pickerel's skin has a strong secretion that will kill other frogs put in the same jar of water.

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Feast Day in Kapingamarangi

BY W. ROBERT MOORE

With Illustrations from Photographs by the Author

"THERE it is! There's Kapingamarangi." The youthful skipper of our small ship lowered his binoculars and thrust them toward me.

Through them I could distinguish only a hazy line dead ahead on the horizon. But it was our landfall, and I was seeing a hope become fact.

Months before, my interest in Kapingamarangi had been aroused when an officer at the Navy Department in Washington tripped lightly over its musical syllables. Like Kalamazoo or Kealakekua, it was a name I couldn't forget.

Later, in Guam, I learned more about Kapingamarangi from a civil administration official in a discussion of the former Japanese mandated islands of the Pacific, over which the United States now has control.

Uncle Sam's Remote Polynesian Wards

"Kapingamarangi, you know, is Polynesian," he explained. "The language and customs of the people there and at its nearest neighbor, Nukunono, 200 miles to the north, differ from those in all the other island groups of our Trust Territory. The rest are Micronesian.

"Why Polynesian folk should be on these two isolated atolls, hundreds of miles away from any part of Polynesia, no one knows. But there they are" (map, page 530).

As we talked, a comely Polynesian maid smiled at me over my informant's shoulder from a framed photograph on the wall. Her home was Kapingamarangi.

In Truk I learned that an American station ship was due to leave soon on a southern island run. It was scheduled to call at Kapingamarangi, nearly 500 miles to the southward, close to the Equator. When it sailed I was aboard.

A few days later I stood on the bridge watching the Kapingamarangi island mass grow and solidify into thick clusters of coconut palms and heavy green breadfruit trees (page 524).

The sun slipped down into the orange-stained sea when we maneuvered through narrow Greenwich Passage and entered the lagoon. In the short tropic dusk that followed we were afforded only a brief view of the 34 islands which stud the atoll, pear-shaped and seven miles long.

Only a few yellow lights from tiny coconut-oil lamps flickered across the water from two

or three islands near where we anchored in darkness. But our arrival had not gone unheeded.

Numerous outrigger canoes emerged from the blackness and swarmed about our ship. They were slender dugouts, with incurving gunwales and long spidery outriggers, unlike any I had seen in other Pacific islands (page 531).

"There's King David," said one of my shipmates, when a long white canoe swung into the lights of our landing ladder.

Seated amidships in the craft was a bulky figure clad in a khaki shirt and white shorts. Half a dozen bronze-backed paddlers manned the canoe.

Sitting in the boat, overflowing its gunwales, King David looked large. When he clambered aboard he looked even larger, for he is nearly six feet tall and must weigh between 250 and 300 pounds (page 532).

He beamed greetings at everyone on board, and made the rounds to shake hands. Deftly a local trader handled the language exchange, for the chief spoke only a few halting words of English.

Scores of other islanders scrambled aboard and crowded the deck space to see the ship movies.

Whenever American vessels halt overnight at any of the Pacific islands, native villagers are eager to get the chance to watch the motion-picture shows.

I spent an interesting hour studying the play of expressions over their intent upturned faces as they watched Joe Palooka get enmeshed with some shysters in a real-estate and park-promotion scheme.

Movies over, the people again melted into the darkness. But they had left the pleasant rumor aboard that there was to be an island wedding and feast the next day.

Natives Clustered on Three Islands

Early next morning, when I went ashore in a bobbing outrigger canoe, I found preparations for the feast already under way. Women sat in the shadows of their thatched homes and under the trees busily working at piles of coconuts, breadfruit, and *puraka*, or swamp taro (page 528). Here and there men were cutting more coconuts from the towering trees. Several canoes arrived from other islands laden with supplies (page 533).



U. S. Navy, Offshoot

As Tightly Packed as a City Suburb Is Tiny Touhou Island

Most of the 500 people on Kapingamarangi atoll live in the thatch-roofed homes crowded in this semi-circular spot, though a few dwell on adjacent Werua, left, and other islands. Large building in the center is the village church. At upper right breakers from the open sea crash on the encircling reef. Other islands serve as gardens for coconuts, breadfruit trees, bananas, and beds of *puraka*, or swamp taro.

It doesn't take long to meet almost every person on the atoll. The majority of Kapingamarangi's 500 inhabitants dwell on an island so tiny that you can walk around it in five minutes. Most of the rest live on two flanking islands, separated only by narrow water channels which are shallow enough to be crossed afoot at low tide.

Unlike many Pacific islanders, the people here prefer to live in a small, compact community. The other islands are sources of food supply. On them are breadfruit trees, massed coconut groves, pandanus, banana plants, and the *puraka* beds.

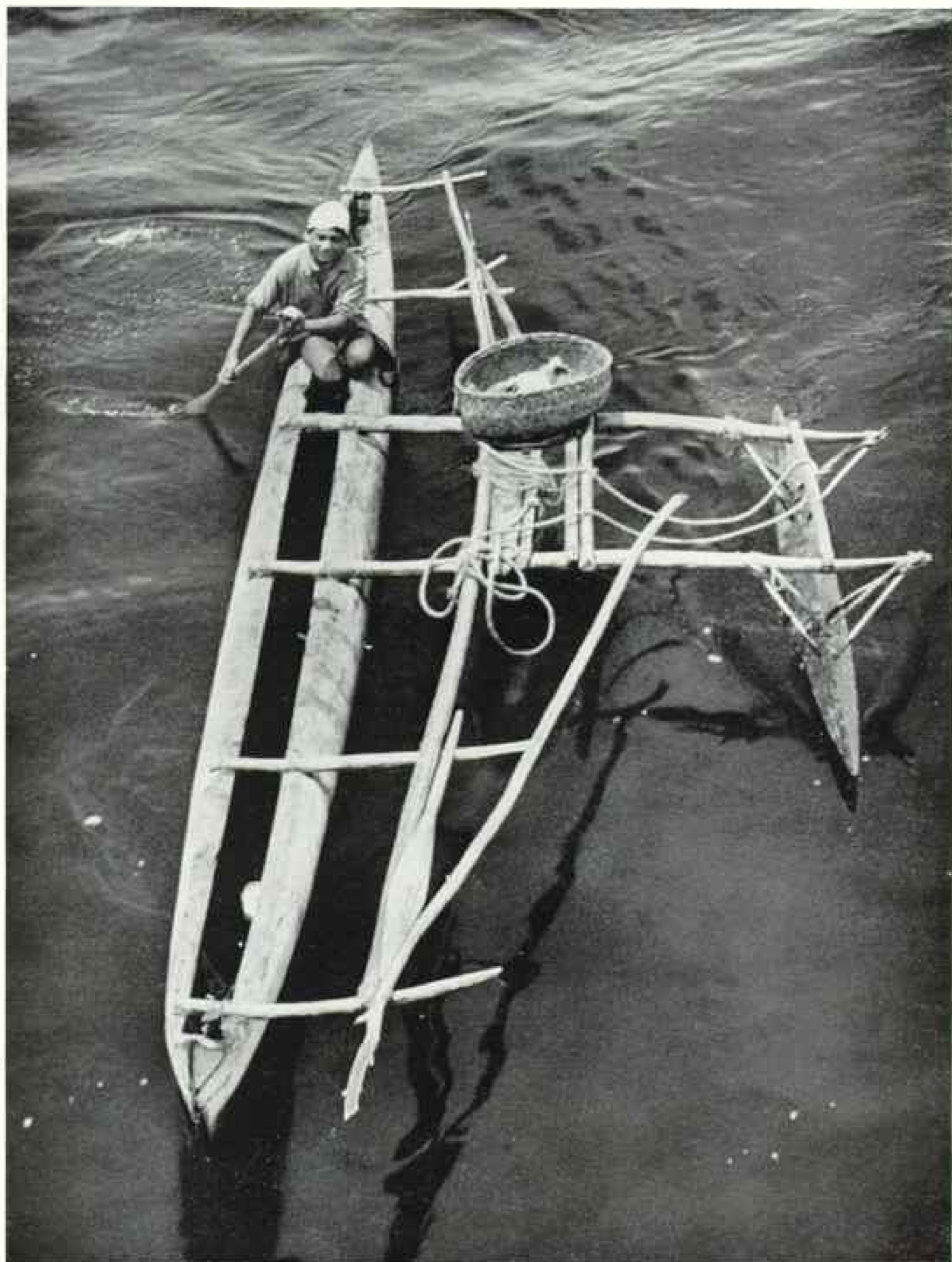
Here at Kapingamarangi the *puraka*, with larger leaves and longer stalks but with a comparatively small, hourglass-shaped root, has supplanted the common taro in recent years. It was introduced from Nukuoro and thrives better in the sunken beds than the original taro, which produces a large columnar rootstock.

To get to the outlying island "farms," every family has its outrigger canoe. Numerous craft shuttle about the atoll on food-gathering missions (pages 526 and 533). The reef and the lagoon are combed for fish and other sea foods.



Pigs, Fattened for the Feast, Are Cut Up for the Island's Fireless Cooker

Womenfolk will wrap the meat in leaves, place it on heated coral pebbles, then cover it with more leaves, mats, and a layer of sand (page 528). Left for hours in the pits, the pig becomes thoroughly cooked. Leaves of the pandanus against which the woman leans are used in making mats; its shredded fiber is woven into handicraft articles. The tree also produces large edible seed clusters.



A Wide Spidery Outrigger Keeps This Loglike Kapingamarangi Canoe from Upsetting

Its design, introduced from Nukunono, has largely replaced a differently patterned craft once used in the islands. The long hull is carved from a large breadfruit tree. Outrigger parts are fastened with coconut-fiber twine. Every family in the atoll has a canoe for gathering food and fishing (page 524). Some craft such as this are paddled; others are fitted with triangular sails.



Soap in the Raw: Workmen Busily Sack Copra for Dispatch to a Waiting Ship

The dried coconut meat is taken from the tin-roofed storehouse, weighed, and bagged. It will be loaded in outrigger canoes and carried out to the small U. S. Naval freighter anchored in the lagoon. Thence it will go to the United States, where its oil will be extracted for soap, oleomargarine, and vegetable shortening.

Throughout the morning I progressed from greeting to greeting among the golden-brown villagers, and from one activity to another. My cameras were busy with pleasant, willing subjects. Almost everywhere I paused I was offered a fresh young coconut to drink.

Some of the women were grating ripe coconuts and straining the flaky white meat with water to produce coconut "cream." Others were scraping and cleaning puraka roots.

Still other womenfolk were preparing ripe breadfruit. It was a seeded variety, locally called *bon*, from the fact that it had been transplanted here from the island of Ebon in the Marshalls.

First the outer skin was pared away, then the fruit was gently squeezed to loosen the stem core. Holding the fruit in her hands, the worker would then grasp the end of the core in her teeth and pull it free.

Kitchen Equipment Simple

The hole thus left was filled with coconut cream, and the opening plastered shut with a bit of pulp pinched from the side. Following that operation, the fruit was wrapped carefully in green breadfruit and banana leaves and was ready for the oven.

I watched several other food dishes being similarly wrapped. Some foods were placed



What Bread Is to the American Household, Taro Is to These Island Folk

Housewives grate the hourglass-shaped roots of the *puraka*, or swamp taro, which thrives better on Nukunono and Kapingamarangi than does the more common thick-rooted variety grown on other Pacific islands (page 524). From *puraka*, green and ripe coconuts, breadfruit, and bananas, used singly or together, skilled cooks make some 22 different dishes! Woven coconut-leaf mats serve as work tables.

in coconut shells, which serve as natural casseroles.

American housewives, used to gleaming kitchens with shiny pots, glass baking dishes, mechanical mixers, and electric ovens or gas ranges, would find themselves baffled by the simplicity of the Kapingamarangi "kitchen."

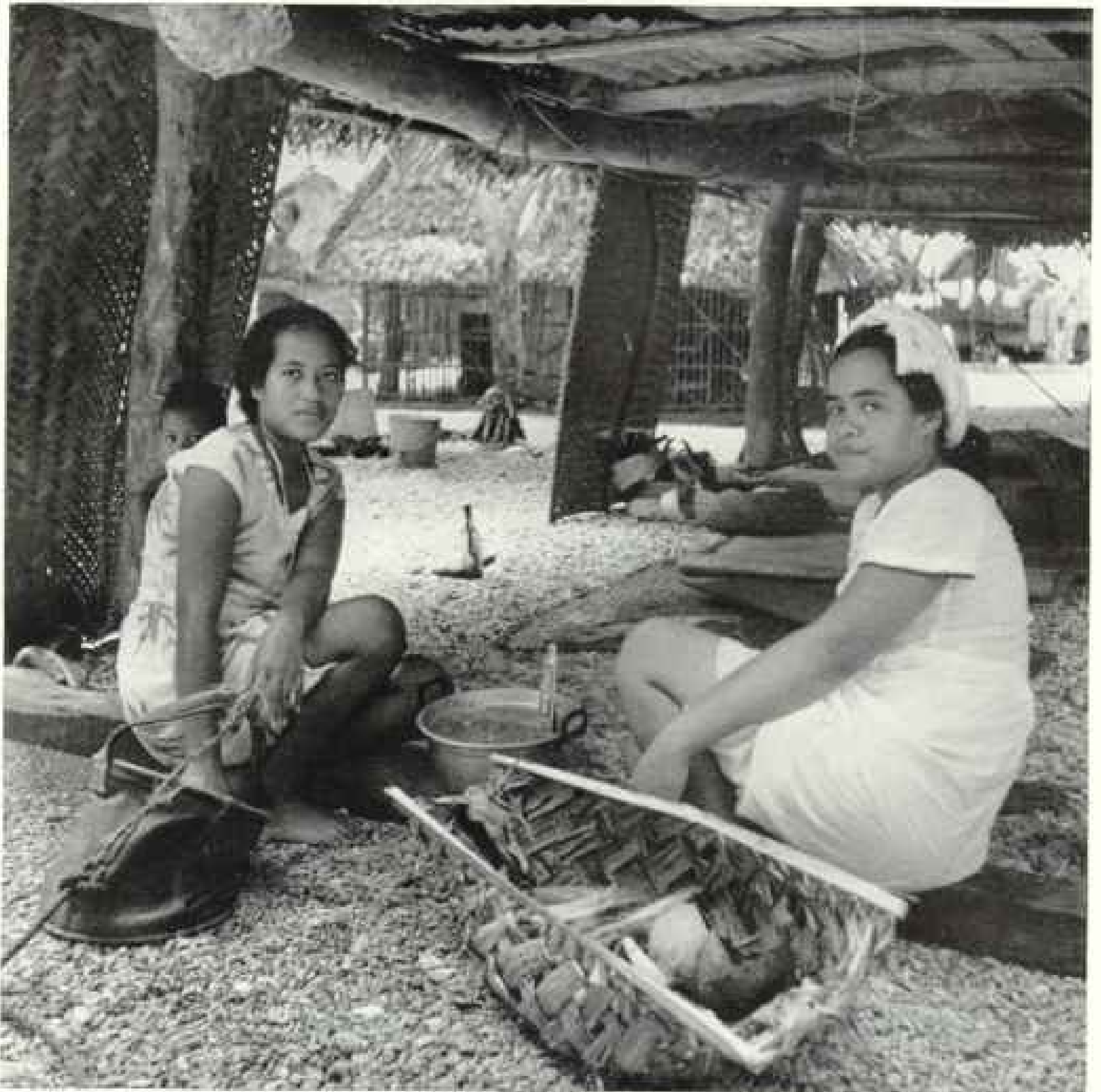
For an oven the women here make a small pit in the ground and in it build a fire of dry coconut husks or other debris. Coral pebbles are then heaped over the fire.

When the pebbles are thoroughly heated, the food is placed upon them and covered with leaves, mats, and a layer of sand. Hours

later, the pit is opened and the fully cooked contents are removed, still in heat-sterilized wrappings and shell casseroles.

Housewives have a few imported kettles in which to boil foods over open fires, but for the most part they use only locally made utensils—hand-carved wooden bowls and pounders, wooden spoons, coconut shells, and sea shells.

I also saw several aluminum pans in use, but they had been fashioned from fragments of wrecked airplanes. Aluminum salvaged from an American plane that had exploded over the island, I was told, was far superior to that from Japanese aircraft. It was thicker



A Discarded Collapsible Navy Bucket Does New Duty in Kapingamarangi

It and an aluminum pot supplement the meager cooking utensils that serve housewives. Islanders prepare food in mortars and bowls hewn from wood and use sea shells as plates, coconut shells as casseroles. Many dishes are baked in breadfruit- and banana-leaf wrappings (page 527).

and would stand more beating when it was being shaped.

In my "kitchen tour" I found another method of preparing breadfruit. Fruits of the common seedless variety were placed directly on hot pebbles and live coals. After thorough roasting they were removed and cleaned of their fire-blackened rinds. The pulp was then pounded into a doughy mass in a wooden mortar with a wooden hand pestle.

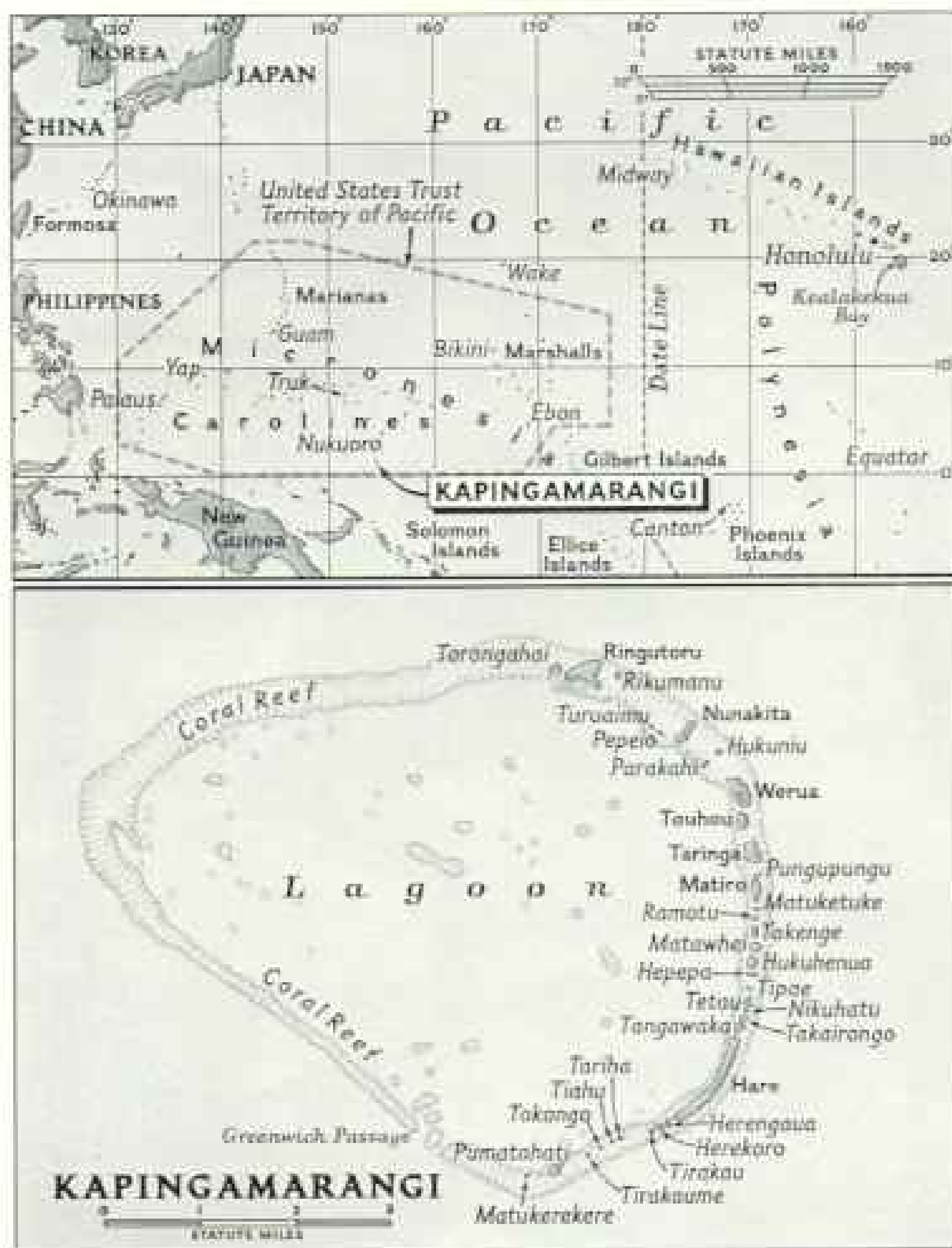
Still a mystery to me are many of the foods prepared that day. Using only coconuts, breadfruit, and puraka, singly or in combination, Kapingamarangi cooks are reputed to produce some 22 different dishes!

One delicacy that intrigued me was a taro fritter, cooked in coconut oil.

Many times when I passed near the schoolhouse, I saw one woman patiently tending two steaming kettles. Hour after hour she stood by them, stirring the contents and keeping the fires going (page 533). Fragrant odors issued from the simmering pots. Later I learned that she was making a coconut custard to be served as dessert.

By midmorning two pigs tethered to the coconut trees in the village had been led to the slaughter. Chickens squawked their last. Rice and fish were cooking in other kettles.

In the afternoon several canoes arrived from



Drawn by H. E. Eastwood

Pear-shaped Kapingamarangi Lies 75 Miles North of the Equator, 200 Miles from Its Nearest Neighbor

Formerly one of the island groups controlled by Japanese mandate, the atoll now is part of the United States Trust Territory of the Pacific. Local Polynesian names for the 34 islands dotting the reef replace those used on Japanese maps. The new spellings are furnished by the Bernice P. Bishop Museum, Honolulu, whose staff recently spent months studying the culture of these people and those of Nukunono to the north. Small ships can enter the lagoon through Greenwich Passage, but skippers must watch for dangerous coral heads.

other islands in the atoll with still more food. Women and girls lugged basket after basket to the thatched-roof schoolhouse which was to serve as the feast pavilion.

"Dress for Dinner" in Mother Hubbards

When the people were busy at their many duties, they dressed in everyday attire. Most of the women wore simple lava-lavas, or skirt-like loincloths; the men were clad in either lava-lavas or trousers.

When they had finished their tasks they

clustered about the shallow wells or went to the lagoon to bathe.

Soon they began appearing in their Sunday best, which for many women meant Mother Hubbards or voluminous long dresses. The men donned shirts with their trousers, and a goodly number even blossomed forth in neckties and coats.

An hour before sunset everyone had gathered for the wedding (page 537). Not until I saw the wedding party assemble did I learn that it was to be a double wedding. The young folk were from four of the most honored families on the island.

Bridegroom Samuel I knew. In Truk he had studied first aid and enough simple medicine to take charge of the island dispensary.* That morning he had been clad only in a pair of navy trousers while he was assisting the pharmacist mate from our ship.

Now he appeared self-consciously in a black coat several sizes too small, gray navy trousers, a white shirt and necktie, and a pair of GI combat shoes. The other groom wore a black suit.

The brides were attired in bulky ankle-length gowns, one white, the other gray-green, on which were clusters of colored ribbons. Several bright ribbons decorated their hair.

While the quartet stood uneasily in front of the school pavilion, with the other islanders sitting on the ground roundabout, King David came forward and delivered a brief talk (page 532). The minister spoke a few words and a blessing.

* See "Pacific Wards of Uncle Sam," by W. Robert Moore, NATIONAL GEOGRAPHIC MAGAZINE, July, 1948.



Outrigger Canoes Swarm Kapingamarangi's Blue Lagoon When a U. S. Ship Calls

The vessel, on an island inspection trip, carries civil and medical officers, also trade supplies. Villagers bring out green coconuts as presents. Kapingamarangi and near-by Nukunono are isolated Polynesian-inhabited atolls.

Dressed in Sunday Best, Two Island Couples Are Wed

Behind them stands King David, chief of the atoll, who weighs some 250 to 300 pounds. Seated to the right is the minister, father of the groom nearest him. Samuel, at left, having studied first aid and simple medicine at the hospital in Truk, has charge of the local dispensary.

For the wedding the men have dressed in western clothes, complete with neckties, vests, and shoes. Brides, however, are barefoot, though they have donned beribboned dresses.

A large feast followed the wedding. The bridal party and favored guests were seated at tables in the schoolhouse seen here; others sat on mats spread outside on the coral sand. Food came in banana- and breadfruit-leaf wrappings straight from the ovens.

To be married on Kapingamaring, islanders need only announce their intentions to the chief. Customarily, they live with the man's parents for a while, then go to the bride's home. Later they are free to establish their own home.

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Kapingamarangi Villagers Work All Day Long to Prepare Hundreds of Dishes for the Wedding Feast

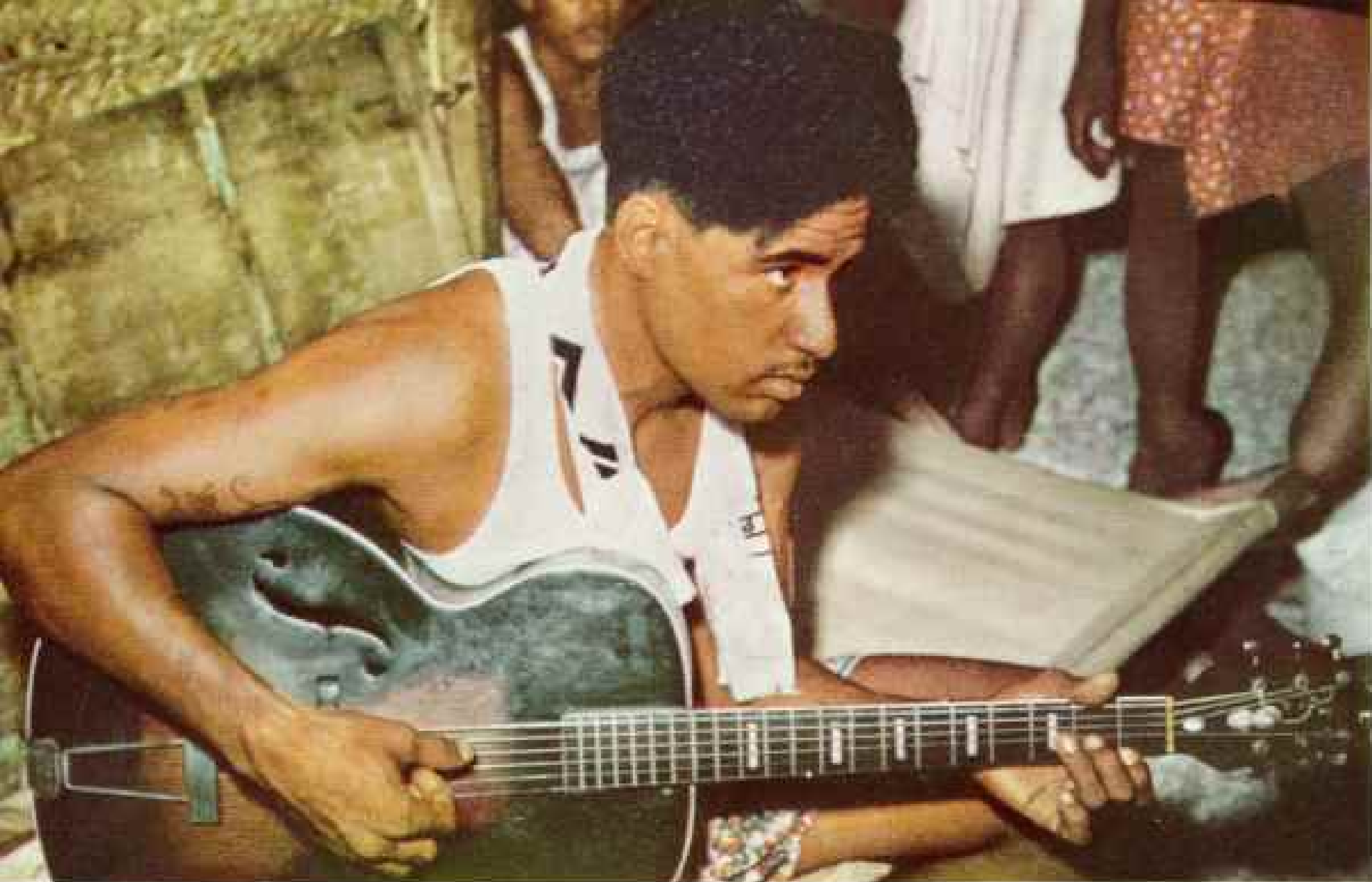
On the previous day men had journeyed to several islands in the atoll to gather taro, yams, coconuts, breadfruit, and bananas for the women to prepare. Here an outrigger arrives with baskets of food. Some cooked in coconut-shell casseroles, others wrapped in leaves. The woman at right stirs two large dishes of coconut pudding.

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Kochanum for W. Robert Moore





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Korlethruener by W. Robert Moore

★ Bridegroom Samuel Entertains Villagers Following His Wedding

Feast over, he has shed his nuptial garb and plucks light tunes on his guitar. He brought this instrument from Truk where he studied first aid (page 537). It was the only one in Kapingamarangi.

✧ Village Youngsters Sit on Mats to Watch the Ceremony

Best part to them was the feast that followed! Two mothers and one youngster have put on their Sunday best; others wear the usual skirtlike lava-lavas. Youngsters here are happy and healthy.



Dr. Peter Buck, Director of the Bishop Museum in Honolulu, who with three anthropologist companions had been studying Kapingamarangi customs for three months, was asked to add a few remarks.

To be married here, the couple need only announce their intentions to the chief. Customarily, they live with the man's parents for a while, then go to the bride's home. Later they are free to establish their own home.

Ceremony over, the islanders queued up to congratulate the newlyweds. Some shook their hands; others rubbed noses in true Polynesian fashion; a few women shed tears.

Wedding Feast Followed by Music

Then came the feast. As honored guests, Dr. Buck and his companions and some of us from the ship sat with the bridal party and relatives at tables under the thatch roof. We ate from plates secured from the Japanese. The rest of the villagers sitting outside ate directly from the leaf-wrapped packages.

I relished every dish and ate until I was thoroughly satisfied. With a few such feasts my girth would rival that of King David, particularly as the foods are mostly starches.

After the feast was finished, I heard the strumming of a guitar near by. I found Samuel sitting in the midst of an admiring group of young folk, plucking tunes on an instrument he had brought from Truk (page 534). He already had shed his formal garb of the wedding, as had many others.

The tropic night settled abruptly over the island. As the Bishop Museum men had a small electric generator unit, members of the ship's crew had brought the motion-picture projector ashore to treat the islanders to a movie.

For two hours an enthusiastic audience cheered, clapped hands, laughed, and gazed with eager interest as Pluto the Pup and Donald Duck romped across the screen. The Brooklyn Dodgers played baseball, swimmers exhibited fancy dives, and Hollywood stars sang.

A film showing the canyons and skyscrapers of New York brought gasps from these folk who had seen nothing larger than thatched canoe sheds and tall tufted palms.

Next day was Sunday. When I came ashore, there was none of the bustle I had seen the day before. King David and most of his people are Christian and believe that no work should be done on Sunday.

Part of the cooking on the previous day had been for the whole week end. The men had halted their work on copra, boatbuilding, and sundry tasks. My picture-taking wasn't considered work, so I did not incur disfavor.

Bell announced midmorning church service. As the churchgoers began trooping to the large thatched church, they formed a striking assemblage, dressed in their best as they had been the night before. Many women and young girls arrived, however, with their dresses still folded over their arms. At the doorway they would pause, slip their "new look" gowns over their lava-lavas, then go in.

Upon leaving, many women carefully removed their formal garb. Youngsters pulled off their finery and fled.

The island has been Christian only since 1922. Prior to that, it had its traditional priests and a temple.

I talked with gray-whiskered Henry, an elderly native minister from Nukuoro, who told me he had fostered the island's change.

"When I came here in 1922," he reminisced, "the temple stood where the church is now. The people had all kinds of tabus.

"That island over there," he said, pointing to adjacent gemlike Taringa, "was all tabu; no one dared stay there overnight.

"I told them I would go there and live, to prove their beliefs wrong. I planted coconuts there and made paths. Now look at it! Nothing happened to me and they believed me.

"Afterward we took the temple to the beach and burned it, and built our church."

Only remnant of the past is a big coral slab which stands upright behind the church. It serves as a monument to Utumatua, supposed discoverer and first chief of the atoll.

When I first came ashore, my attention was centered mainly on the work of the women preparing the feast.

The Men Work, Too!

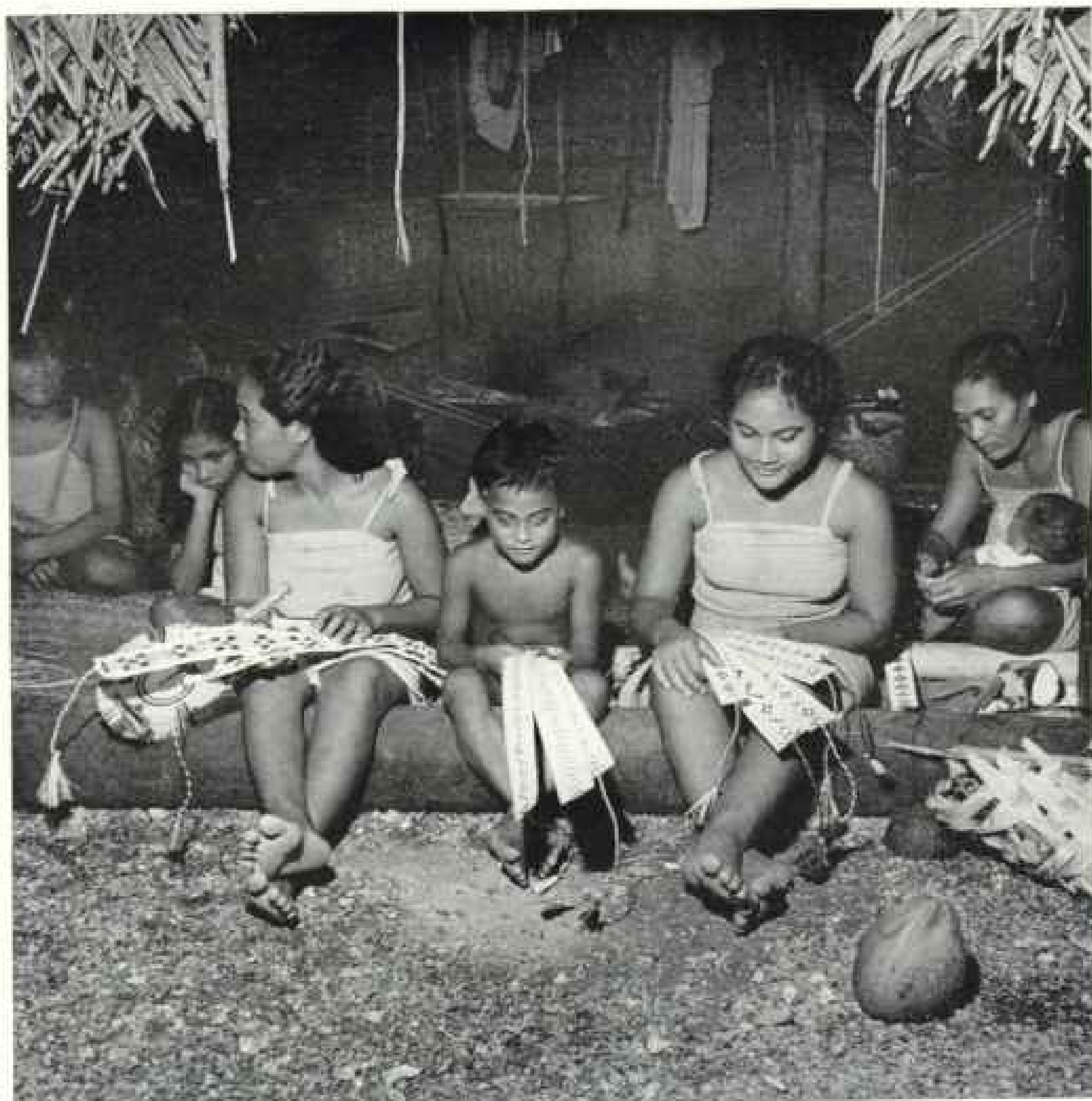
But the Kapingamarangi men also were busy. They climbed the coconut trees, slaughtered the pigs, and supplied fish and other provender.

Still other men were preparing copra for export (page 527), building canoes, thatching houses, and erecting a new dispensary.

Many tasks are community enterprises. Secondary chiefs who serve under King David decide, for example, when a home needs thatching.

Each village householder is then called upon to furnish a specified number of bundles of thatch. When these arrive, the men fall to, and within an hour or so the roofing job is completed.

At the time of my visit a number of men were building a larger dispensary. Oddly enough, the whole roof assembly was almost completed and sat in an open space near the beach. Walls still were nonexistent.



Deft Fingers Turn Strands of Pandanus Fiber into Belts and Fans for Trade

Patterns are woven with strips colored with whatever dyes the people can obtain. Some are locally made vegetable dyes; but inventive weavers even use blue carbon paper secured from visiting American ships. These handicraft articles and copra from coconut trees provide the islanders with funds for cloth, rice, and other imported items.

The corner posts and a studding would be erected later on the site where the building was to stand; then the roof would be carried there, hoisted into place, and thatched.

The island has well over a hundred canoes, but I saw others being built. There are several expert canoe builders on Kapingamarangi. But, as with house construction, the fashioning of a dugout is a joint project.

Building Canoes of Breadfruit Wood

When a new boat is to be built, one man is placed in charge; other helpers follow orders, though they may be as expert as he.

From the time the large breadfruit tree is felled until the canoe is completed, he directs the hewing and gouging of the hull and fitting of the outrigger.

Most Kapingamarangi canoes today follow a design said to have been brought from Nukuoro. The long slender hull curves in at the gunwales, giving it a rounded loglike shape.

The long outrigger float is attached to the hull by two booms lashed into place with coconut-fiber twine. Further supporting the booms is a stringer, held by shorter booms, which extends almost the entire length of the canoe (page 526).



All Kapingamarangi Attends the Wedding and Eagerly Waits to Congratulate the Brides

These cheery well-fed islanders, together with those on Nukunoro, are the only Polynesian folk in American-controlled Micronesia, formerly Japanese territory. The thatch-roofed, matting-walled building in back is the village church, erected on the site of a pagan temple when the people became Christian in 1922 (page 535).

This craft unmistakably reflects its Polynesian origin, as does the older canoe of Kapingamarangi. Both are unlike any other boat types found in Micronesia.

Some of these dugouts are paddling canoes; others are equipped with triangular sails. Often these graceful white-sailed craft skim before a fresh breeze across the lagoon or on a fishing expedition out in open sea.

One spectacular sight in Kapingamarangi is when several fishing crews catch flying fish outside the lagoon at night. With each canoe bearing a flaming torch, the fishermen ride the inky waters and deftly dip up the iridescent fish lured by the light. Catching flying fish is

more of a sport than a humdrum task of garnering food.

On the afternoon that we sailed, it seemed as if all the canoes in the atoll were clustered about our ship. Many appeared ready to sink from the number of persons aboard. Even King David rode out in his big white canoe to say farewell.

Some islanders, however, had remained ashore, for we could see the blinking of hand mirrors as they flashed them in the sun.

Regretfully I watched our wake whiten as the engines picked up speed. We swung away from the waving throng riding the canoes and headed for the lagoon passage.



Lunch on His Arm, a New Rug over His Shoulder, This Smiling Okinawan Symbolizes the New Hope That Has Come to the "Doorstep to Japan"

Battles and typhoons have ravaged little Okinawa during the past five years, but today there is cause for cheer among the island's people. Thrust again into strategic prominence by recent crises in China and Formosa, long-neglected Okinawa is undergoing a face lifting. After the transformation it will be a semi-permanent, well-equipped United States airbase similar to Clark Field in the Philippines.

A 71-million-dollar appropriation bill passed by the 81st Congress last October will bring new typhoon-resisting housing, improve harbors and roads, provide warehouses and recreational facilities.

Shaped like a water snake swimming northeast in the subtropical East China Sea, Okinawa became the last costly battle of the Pacific in the series of steppingstone campaigns from Australia to Japan. D-Day was April 1, 1945. The northern half of the island was quickly taken, but in the south the Japanese, holed out in caves, fought savagely for 82 days. Our casualties were high—11,861 dead, including Lt. Gen. Simon Bolivar Buckner, Jr., brilliant commander of the Tenth Army.

Okinawa was slated as jump-off point for the invasion of the Japanese mainland. Within six weeks of its capture, 24 airfields had been constructed, capable of sending out 3,500 B-29 bomber missions a day. Then came V-J Day, and Okinawa with its half-million people slipped back into obscurity.



539

Bureau Official

✦ Okinawa's Typhoons Put the Finishing Touches on War's Ruins

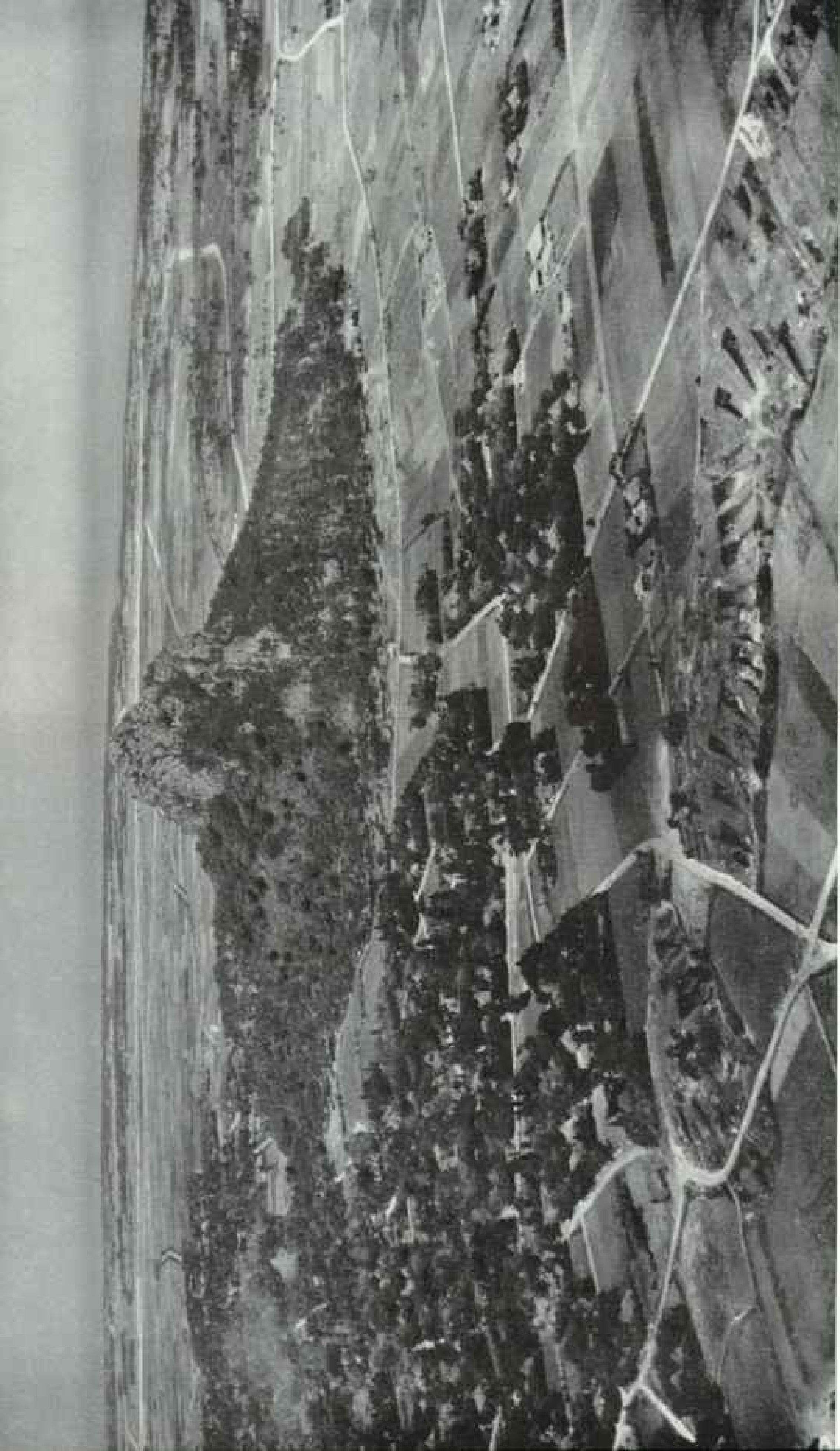
All usable equipment has been shipped out for reconditioning, but scrap piles of rusted, rotted material are still common sights. Native workmen occasionally uncover a workable part from the wrecked vehicles.

✦ With Family Aboard, a Boatbuilder Pilots His Craft Seaward for the Launching

Passengers sit forward to balance the horse-drawn, two-wheeled cart. Stretching ahead is Okinawa's main highway, running north and south the island's length. Its crushed-coral surface is dazzling in the sunlight.

Robert Stohrman





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U. S. NAVY, OFFICIAL

On Ie Shima, West of Okinawa, America's Beloved War Correspondent Ernie Pyle Was Killed by a Machine Gun

American troops waged a hard-fought six-day campaign to capture rugged Iegunago Hill (center). Sunken areas in foreground are stone tombs built in a hillside (page 352).

Shuri, Old Royal Capital, Rebuilds after Thousands of Bombs and Shells Rained Destruction

Ninety percent of the homes on Okinawa were destroyed during the battles. Most fighting centered in the heavily populated southern section of the island. Naha and Shuri, the principal cities, were flattened.

Okinawans build their houses low to the ground and encircle them with rock walls and banks of tropical shrubbery for protection against the winds. Thatch roofs, like the one being laid at left, stand up well in typhoons. Corrugated metal sheets, salvaged from American scrap piles, here serve for walls.

A typical farmhouse consists of one windowless room with a narrow, curtained opening for a door. The floor is packed earth spread with rushes and thin mats. A cooking hearth, a few dishes and utensils, a pile of bedding, headrests for pillows, and a simple family shrine are its only furnishings.

Racially and culturally, the Okinawans stem from a triple combination: Aino, Chinese, and Japanese. The island had its own rulers until Japan took over in 1879, but Nipponese have always viewed the Okinawans as poor country cousins.

Robert Stephenson



**P-80 Jets Patrol Skies
Now Peaceful but Once
Black with Screaming
*Kamikazes***

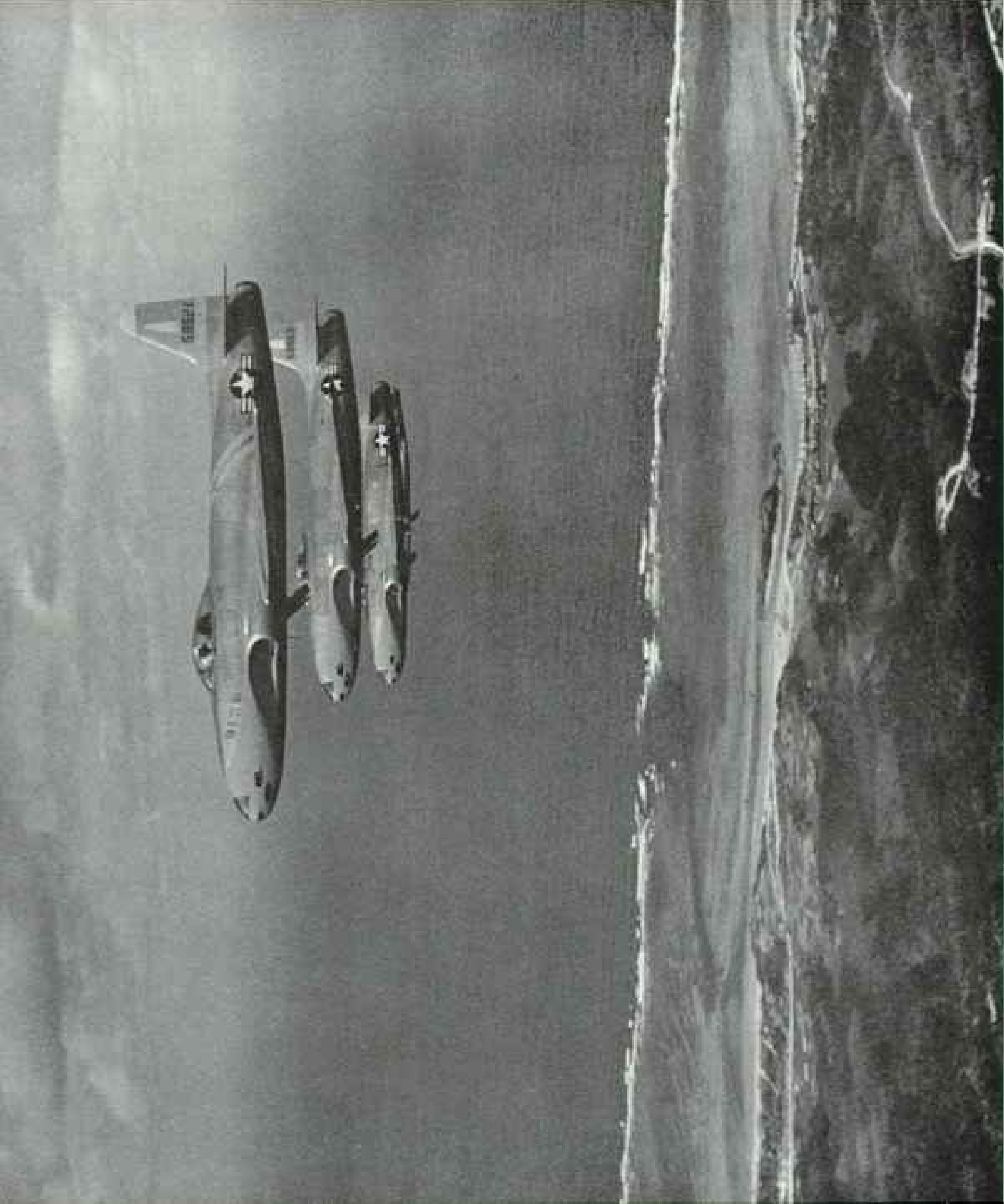
Streaking over Okinawa's reef-lined shores, trim Shooting Stars remind the islanders of the prominent role their homeland still plays in the Western Pacific.

Lying within 600 miles of the China coast, southern Korea, Formosa, and much of southern Japan, Okinawa is ideally situated for airbases. Today it primarily serves fighters, with big bombers flying out of the Marianas.

Typhoons are the major problem for Okinawa airmen. When storms hit, fliers lash jet fighters to the coral hardpan in the open for lack of cement hangars. The United States is spending more to improve facilities here than at any other post in the Western Pacific.

To the half-million men who fought for these 485 square miles of coral rock, Okinawa is vividly remembered for the Kamikazes—the "Divine Wind."

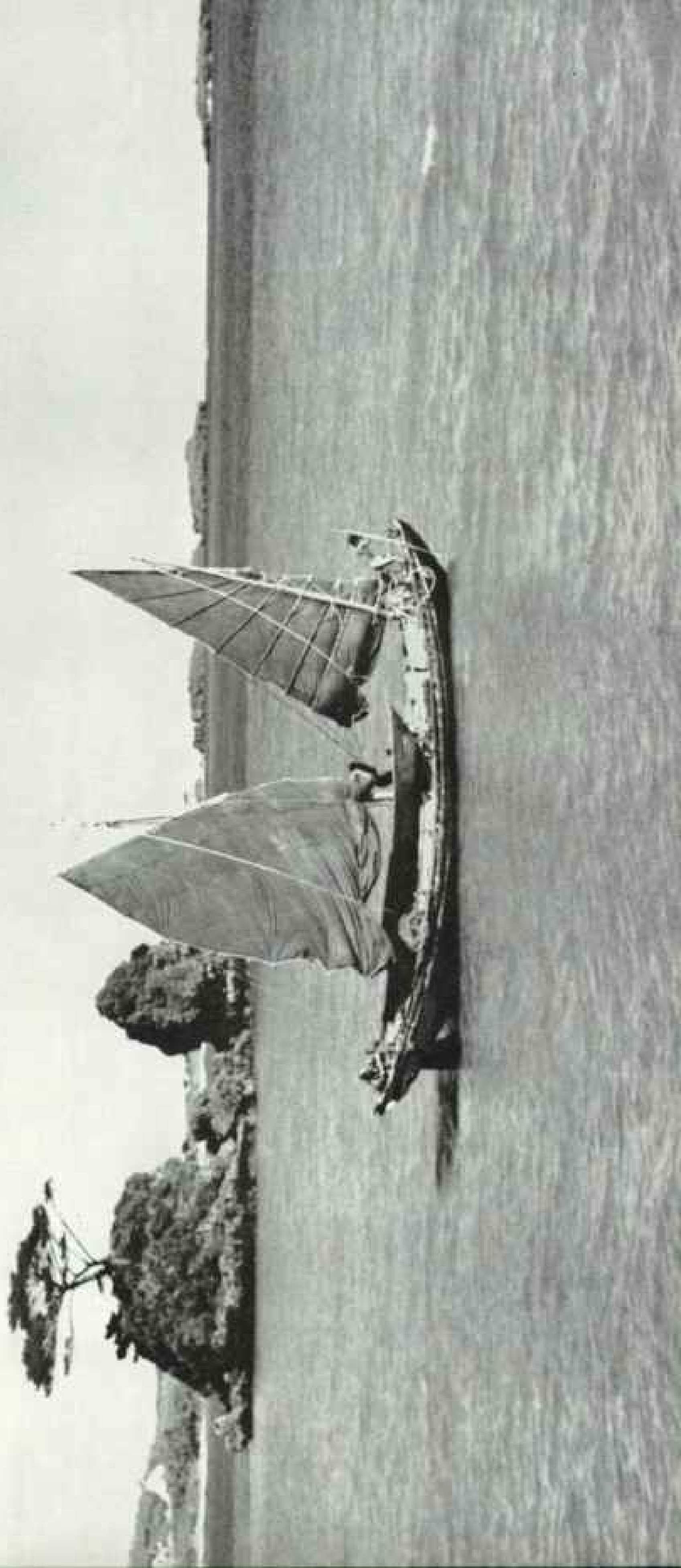
Flying between a low cloud ceiling and gray seas, 300 Kamikazes attacked during one 24-hour period. In one month 160 American ships were hit and 20 sunk.



Junk's Crew Poles Out of the Sheltered Cove; Once Past the Reef Sea Breezes Will Balloon Her Sails

Frail merchant craft ply between southern Okinawa, other parts of the island, and smaller islands in the Ryukyus, trading in foodstuffs. *Saechu*, a cheap liquor distilled from sweet potatoes, is also a common bartering cargo. American administrators plan to revive Okinawa's fishing by underwriting a modest fleet of ocean-going vessels.

Robert H. H. H. H.





Chief of Staff J. Lawton Collins Addresses the Army on Okinawa (Above); Bark of a P-80's Guns Closes Observers' Ears (Below)

But it does not bother mascot Tinkle, perched on a wing, who nonchalantly ignores the rat-a-tat-tat of the 70th Fighter Squadron jet testing its sting.

Even to Okinawa Comes the Self-service Pushcart

As in a big food store at home, Army wives shop in the commissary, housed in a large Quonset, known as a "Butler Building." All food for Americans must be shipped in. Okinawans themselves are only 70 percent self-supporting.



"When the Light Comes On, You Know It's Lit"

Explains Mrs. Edward Fredericks of Washington Court House, Ohio, to her Okinawan maid. Island girls, seldom taller than four and a half feet, are quick to learn; they work for \$5 to \$10 a month.





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HARPER-PIRELLA

Around Naha's Deepwater Harbor, Jeeps, Trucks, and Bulldozers Are Jammed, Awaiting Shipment to Salvage Depots

At dawn on Easter Sunday, 1945, American war material began pouring in on Okinawa beachheads. Five years later, the trend is reversed; equipment is being sent to Japan for reconditioning. Millions of tons of crated ammunition and vehicle parts were jumbled when rain-crooked stencil markings on the boxes.



Industrious Okinawans Build a New Life on the Ruins of the Old

Inured to struggle, they have come back rapidly from war catastrophes. Rebuilding is done on a volunteer basis; a judge of the Okinawa Supreme Court and the president of the Naha Bank may toil side by side with farmers and laborers without special privileges.

Despite this 100 percent cooperative movement, construction experts believe 15 to 20 years will be needed to rehabilitate the island.

In erecting new homes, natives stick to their ancient but reliable tongue-and-groove carpentry, which resists the strongest typhoons. Okinawans are proficient at masonry. At left a native totes cement in a discarded United States Army helmet.

War surplus clothes and rations were given destitute islanders, many having lost everything in the fighting. Most men dress in Army suntans or Marine fatigues, like the young father with piggyback son at right. A common garb for women is a skirt and a khaki GI undershirt.

HORACE PATLAND





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U. S. Air Force, official

When Typhoons Rip Okinawa, 175-mile Winds Snap Telephone Poles, Crush Quonsets Like Matchboxes, Scatter Crates Across Fields
So numerous are these tropical storms that American forces nickname them for identification. Damage to the Quartermaster warehouse above was wrought by "Gloria," which lashed the island last July. Storm alerts enable residents to scurry to caves and concrete structures, keeping casualty lists low.

Typhoon "Gloria" Swept Away Their Washrooms, So 13th Air Force Men Hang Their Clothes on a Tripod and Shower in the Great Outdoors
Last year 92 of the Quonsetta housing American families were destroyed by gales and most of the others damaged. Servicemen oftentimes wrap steel cables around houses to anchor them securely. But winds snatch them off their foundations and crumple them like cardboard. New construction is typhoon resisting.

549

U. S. Air Force Official



**"School's Out!"
Pupils Hop into Getas,
Dash to the Playground**

Wartime bombings left school buildings in shambles, so classes are held in private homes, army tents, and Quonsets.

Textbooks prepared for occupied Japan are brought here and mimeographed. English is a required subject for all students, who are also learning some U. S. history.

During the Japanese regime, higher education was discouraged. When the Americans inaugurated high school in July, 1945—just a few weeks after the island was secured—400 barefoot youngsters, washed and scrubbed, turned out.

A college for Okinawans will open soon. Over 40,000 books have already been collected for its library.

Okinawa's school system is gradually undergoing change to bring about more democratic ways of handling students. Both teachers and students have been accustomed to long years of Japanese "stiff collar," dictatorial teaching.

Elementary instructors receive only \$6 a month, but are given plots of land to raise food to supplement meager earnings.

Robert M. Williams



Like Kids the World
Over, Shuri Small Fry
Call for "Choon Goin"
and "Chocolot"

Thousands of Okinawan youngsters died in the war, and thousands more were orphaned. Soon after invasion of the island, the 6th Marine Division set up an orphanage. Infants were fed canned milk through nipples cut from surgical gloves.

Several orphanages operate on Okinawa today, but, as living conditions improve, adoptions increase.

Ryukyuan children usually appear younger than their years because of the old Japanese method of computing age. A child was considered one year old at birth and added another at the New Year. Thus, a baby born the last day in the year was two next day.

An Okinawan baby is with his mother constantly from the minute of birth. Carrying him on her back, even at work, she gives him a sense of security.

Robert H. H. H.





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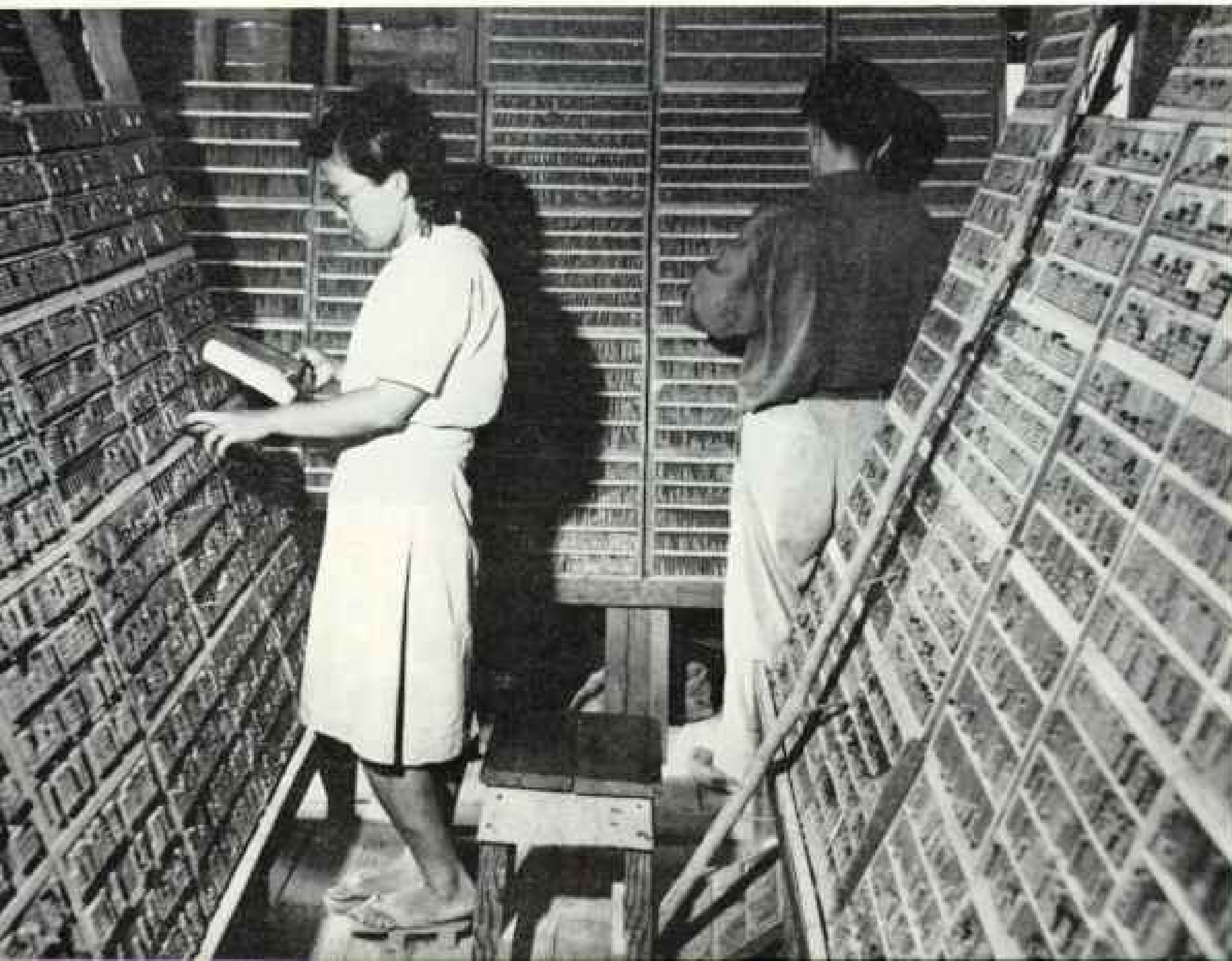
Robert Stalderman

↑ Elaborate Tombs Testify to Okinawans' Concern for the Hereafter

Such vaults are familiar sights in the Ryukyus, where the goal of every islander is a costly houselike tomb. A man who has spent his entire life in a wretched hovel may have a stone tomb worth \$1,000.

↓ Only 10,000 Okinawans Can Read, So Circulation of *Ishikawa Daily* Is Limited

Typesetting this paper is an arduous task, for it is printed in Japanese with more than 7,000 characters. For Americans on the island, the Japan edition of *Stars & Stripes* carries a daily page of Ryukyuan news.



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Articles and photographs are desired. For material The Magazine uses, generous remuneration is made.

In addition to the editorial and photographic surveys constantly being made, The Society has sponsored more than 100 scientific expeditions, some of which required years of field work to achieve their objectives.

The Society's notable expeditions have pushed back the historic horizons of the southwestern United States to a period nearly eight centuries before Columbus crossed the Atlantic. By dating the ruins of the vast communal dwellings in that region, The Society's researches solved secrets that had puzzled historians for three hundred years.

In Mexico, The Society and the Smithsonian Institution, January 16, 1939, discovered the oldest work of man in the Americas for which we have a date. This slab of stone is engraved in Mayan characters with a date which means November 4, 901 B. C. (Spinden Correlation). It antedates by 200 years anything heretofore dated in America, and reveals a great center of early American culture, previously unknown.

On November 11, 1935, in a flight sponsored jointly by the National Geographic Society and the U. S. Army Air Corps, the world's largest balloon, *Explorer II*, ascended to the world altitude record of 72,395 feet. Capt. Albert W. Stevens and Capt. Orvil A. Anderson took aloft in the gondola nearly a ton of scientific instruments, and obtained results of extraordinary value.

The National Geographic Society-U. S. Army Air Forces Expedition, from a camp in southern Brazil, photographed and observed the solar eclipse of 1947. This was the seventh expedition of The Society to observe a total eclipse of the sun.

The Society cooperated with Dr. William Beebe in deep-sea explorations off Bermuda, during which a world record depth of 3,028 feet was attained.

The Society granted \$25,000, and in addition \$75,000 was given by individual members, to the Government when the congressional appropriation for the purpose was insufficient, and the finest of the giant sequoia trees in the Giant Forest of Sequoia National Park of California were thereby saved for the American people.

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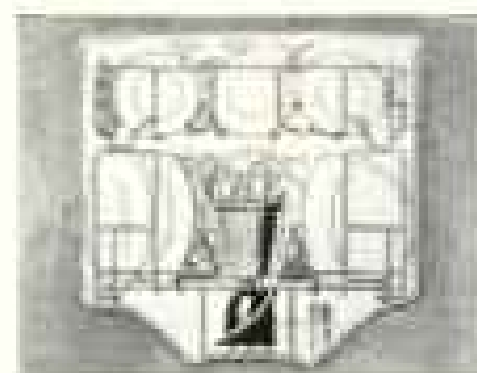
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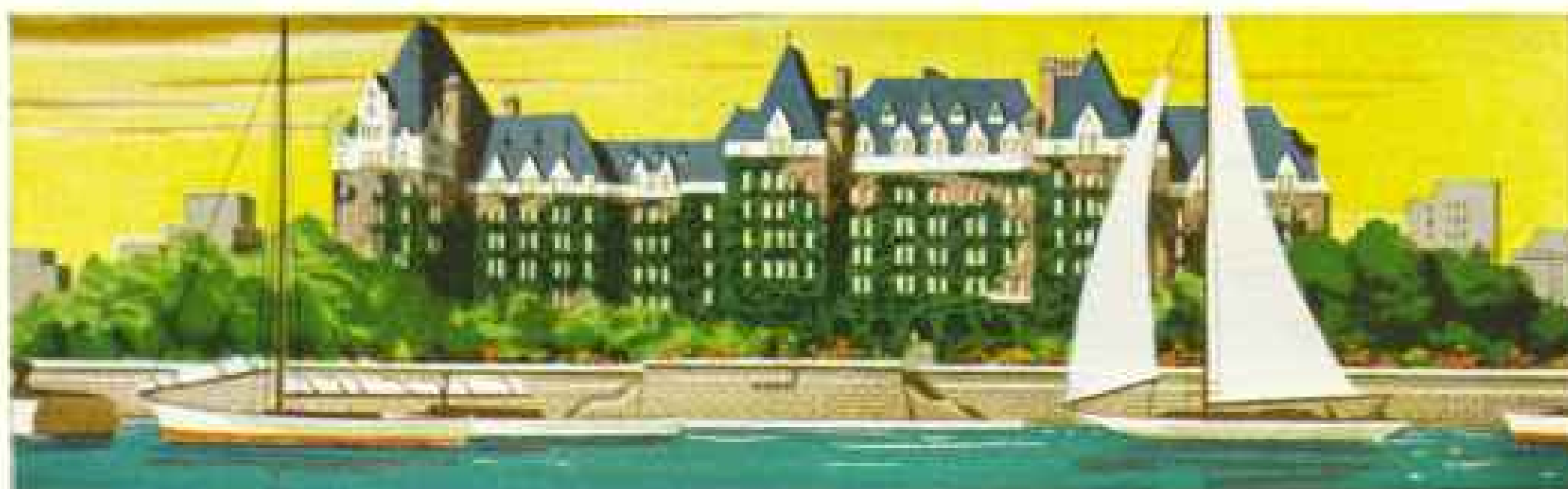
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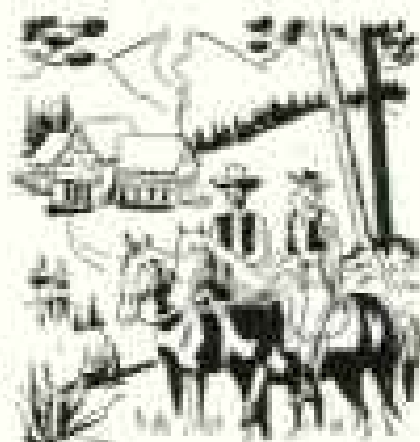
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Left to right: Sewer Service,
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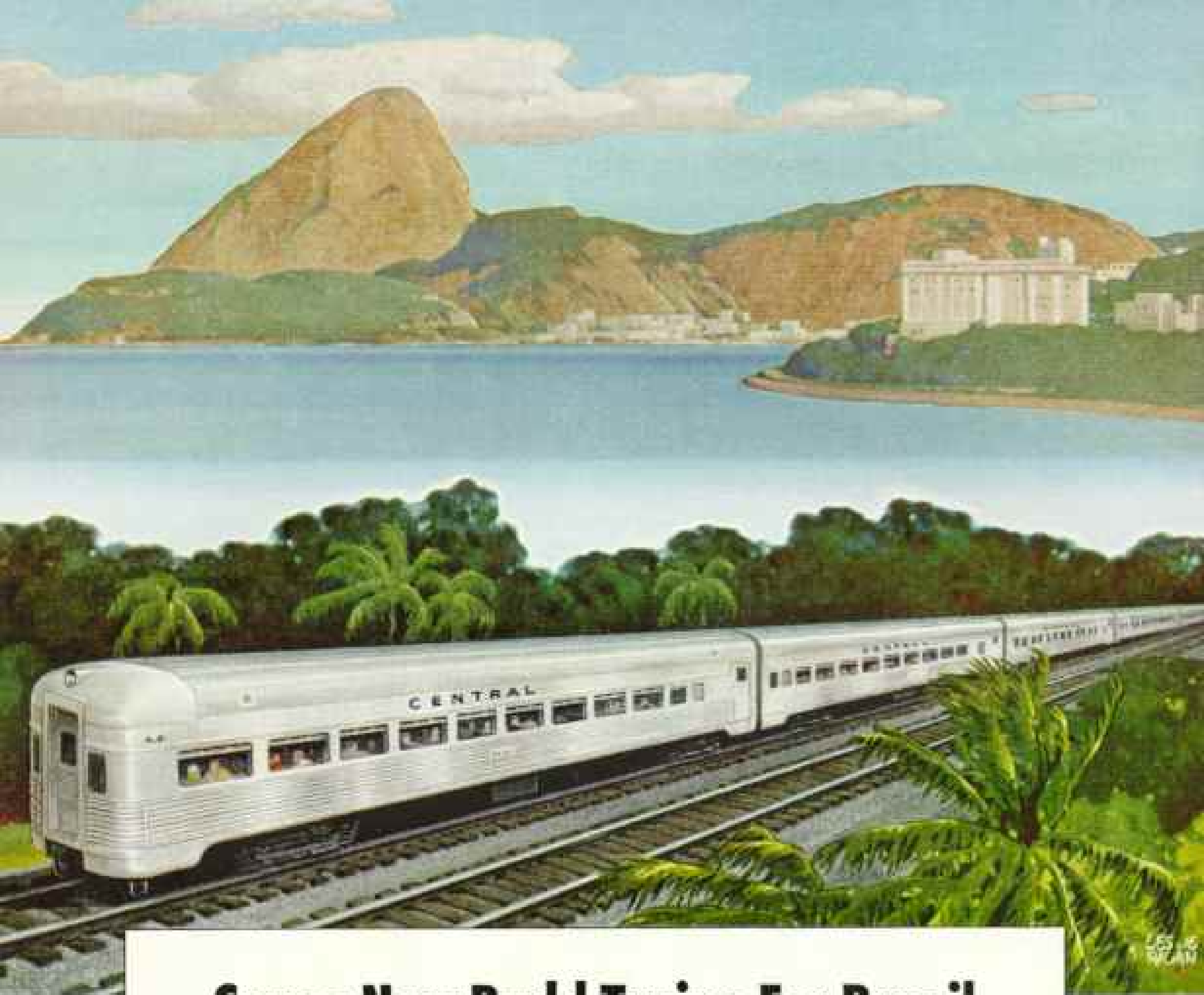
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They have been assembled into seven 9-car trains to provide the capital with daylight and overnight sleeper service to coffee-rich Sao Paulo, and to Belo Horizonte, mining center for diamonds, emeralds and the famous Brazilian tawny aquamarine.

With the inauguration of these trains, Brazil and her visitors enjoy travel in the same kind of superlative equipment . . . diners, sleepers, coaches, observation

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New scintillation counter, using electron tube developed at RCA Laboratories, gives faster, more accurate measurements of atomic radiations.

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possible by a development of RCA Laboratories—can do the job more efficiently.

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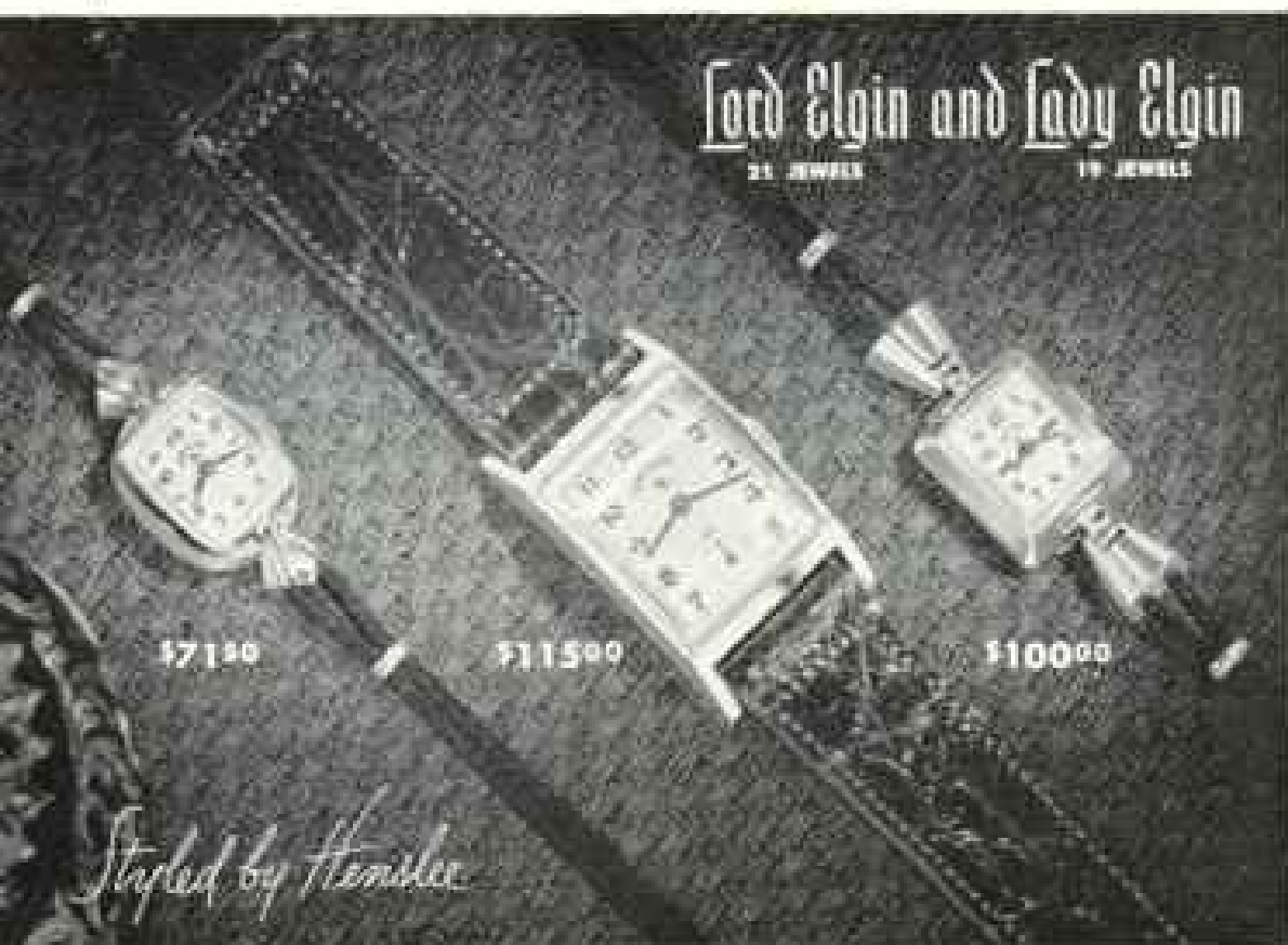
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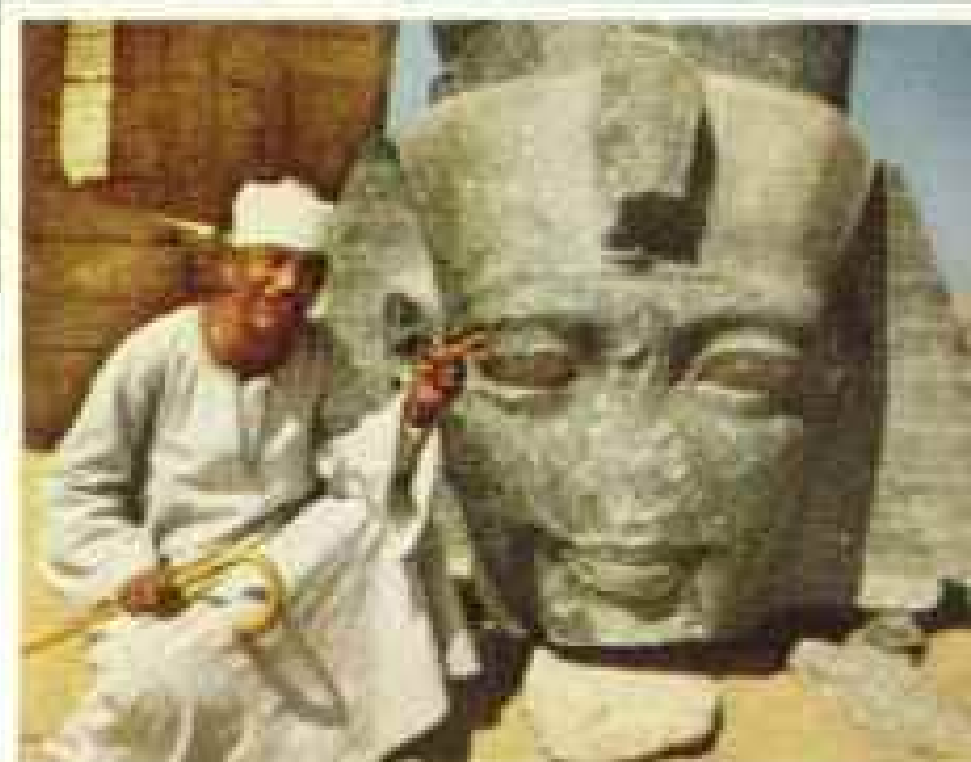
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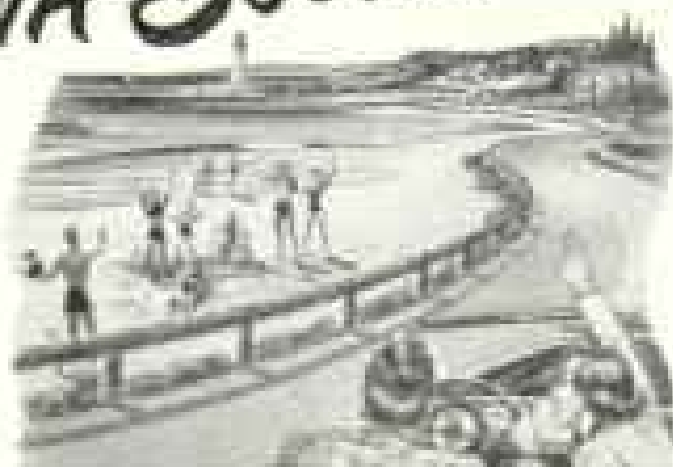
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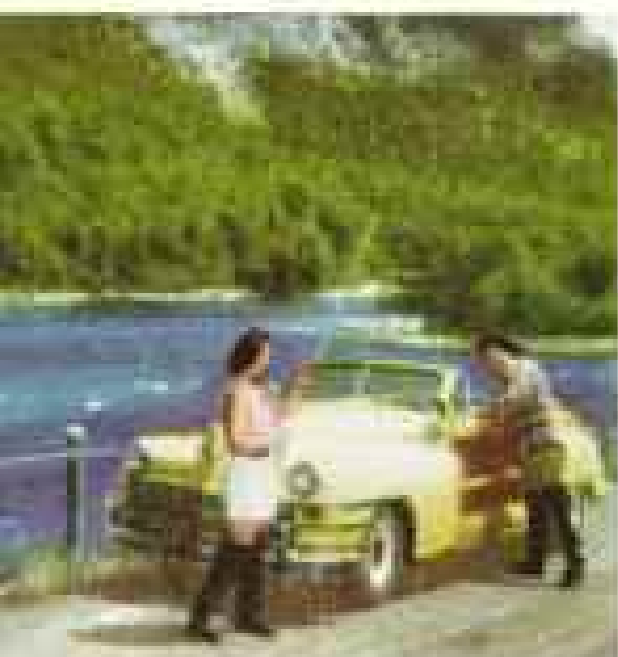
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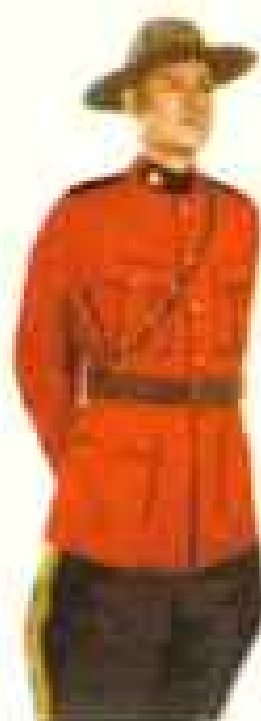
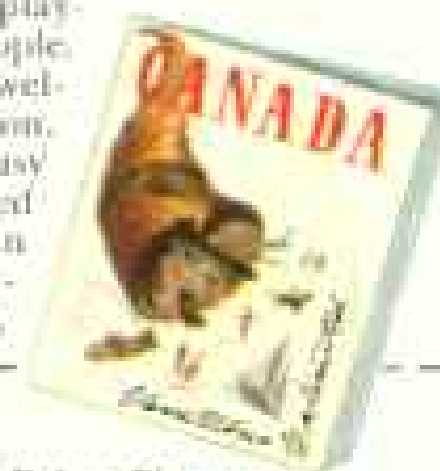


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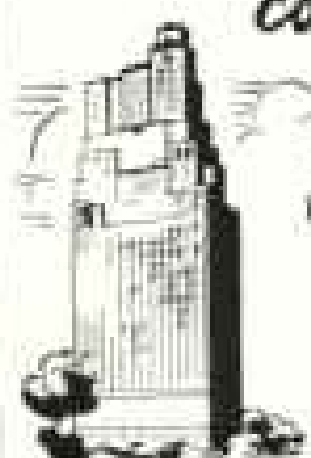
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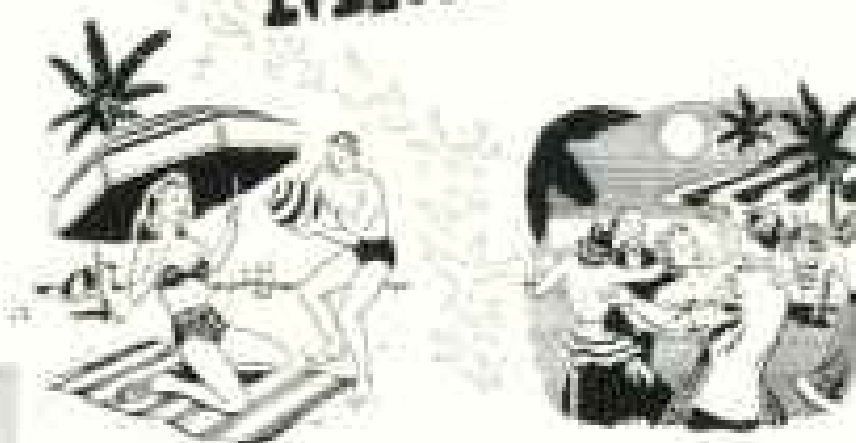
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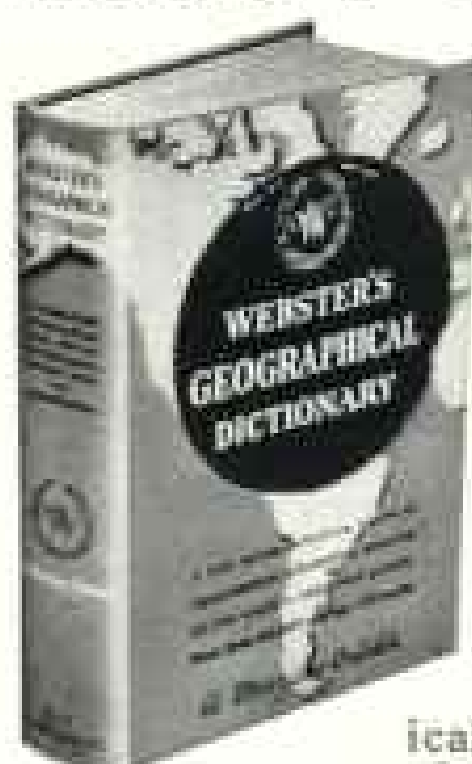
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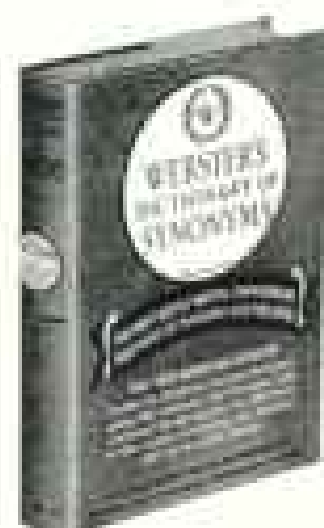
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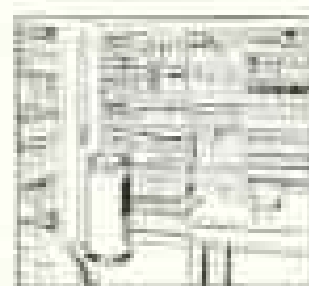
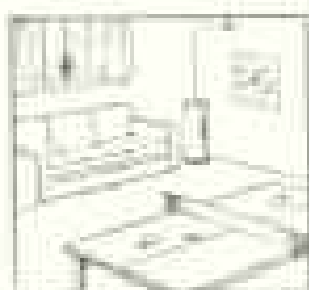


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CANCER

...a progress report

Medical Science is now waging its greatest fight against cancer

As the research attack on cancer progresses, discoveries are constantly being made that offer hope of further gains against this disease.

Today, if diagnosed early and treated promptly and correctly, authorities say that seventy-five per cent of cancers of the breast, eighty per cent of cancers of the mouth, and over ninety-five per cent of cancers of the skin are curable. Cancer of other parts of the body also is being treated with greater success.

Progress in new treatments

Doctors and other scientists are steadily working on the major aspects of cancer. At present, efforts are being made to perfect a simple, quick test to detect the disease early. One such test was recently announced. It is based upon the discovery that the blood serum of persons with cancer has different properties than that of normal persons.

Studies are continuing on the use of radioactive isotopes and drugs to combat cancer. Improvements in surgical techniques are also encouraging.

Your part in fighting cancer

In view of the progress being made by medical science, annual physical examinations are more important than ever in safeguarding against cancer, especially for those over thirty-five years of age.

Authorities urge everyone to learn the "danger signals" of cancer that are listed at the right.

Fortunately, in the majority of cases, they turn out to be symptoms of conditions other than cancer.

There are still no "quick cures" for cancer. The only proved weapons which medical science now has against this disease are X-rays, radium, and surgery.

As medicine's knowledge of cancer increases, there is hope that the time may not be too far off when the disease will yield its secrets and thus cease to be a major threat to life. Meanwhile, with today's weapons—promptly and properly used—authorities predict that an ever increasing number of cancer victims may be saved.

The 7 "danger signals" that you should know

1. Any lump or thickening, especially in the breast, lip, or tongue.
2. Any irregular or unexplained bleeding.
3. A sore that does not heal, particularly about the mouth, tongue, or lips.
4. Noticeable changes in the color or size of a wart or mole.
5. Loss of appetite or continued indigestion.
6. Any persistent hoarseness, cough, or difficulty in swallowing.
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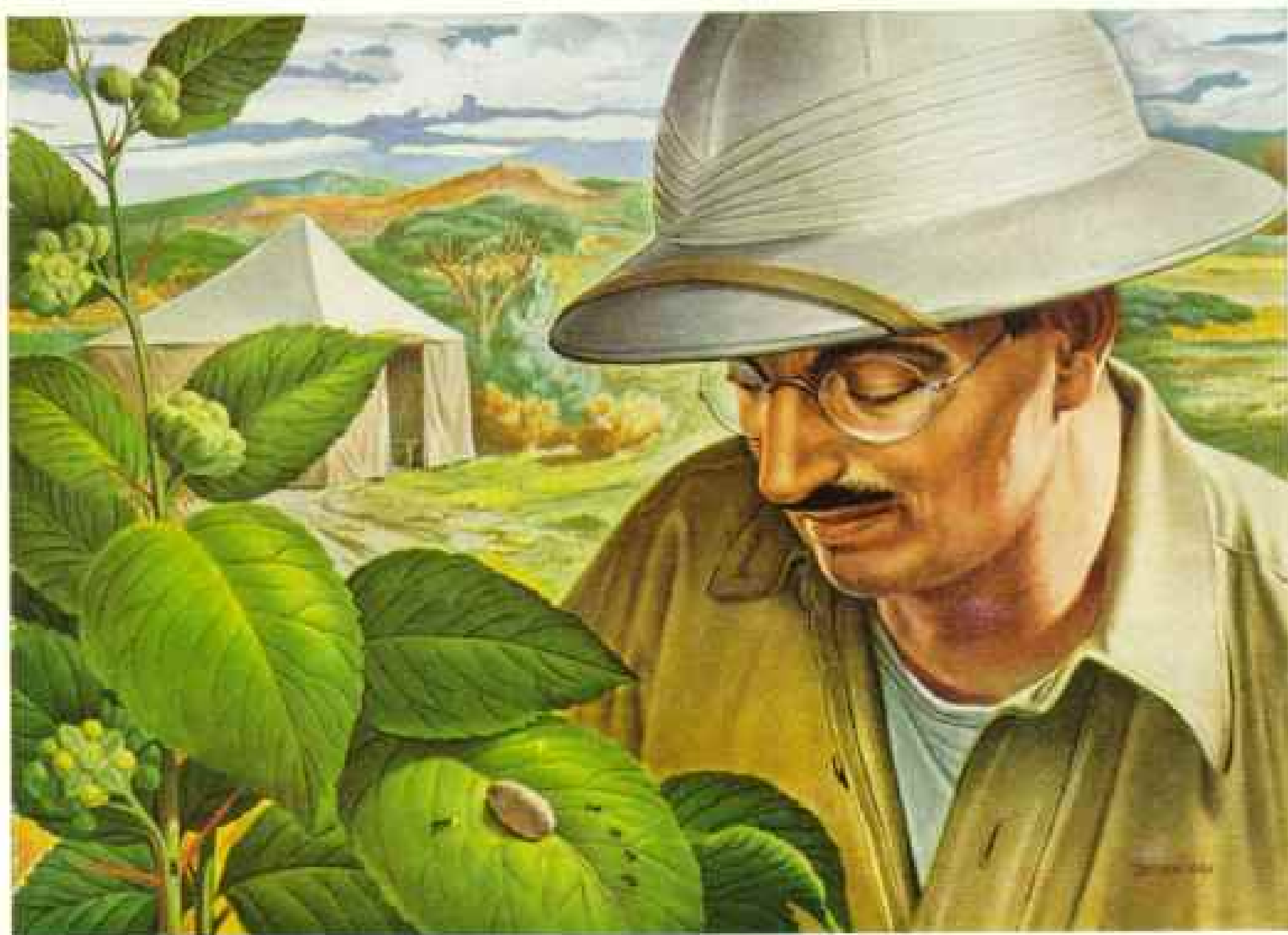
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Dr. Mann found cow barns hanging on a bush

DR. WILLIAM MANN first observed the strange family life of the curious ant, *Polyrhachis simplex*, when he explored the Kerak region of Palestine in 1914.

Small silk-and-leaf structures that the explorer found on bushes near his tent were the tip-off that *Polyrhachis* was living in the vicinity. Each of these structures sheltered leaf hoppers, which exuded a kind of nectar that the ants fed on. The ants were sheltering the hoppers, as humans keep milk cows, to furnish food for the colony.

But it was not until he located the ant nest and followed the trails leading from it that Dr. Mann discovered how the aerial cow barns for the food-producing leaf hoppers were built.

Worker ants were carrying *Polyrhachis*'s newly hatched larvae to the building site. Then, these infants set to work spinning the silk to make shelters for the family's milk cows.

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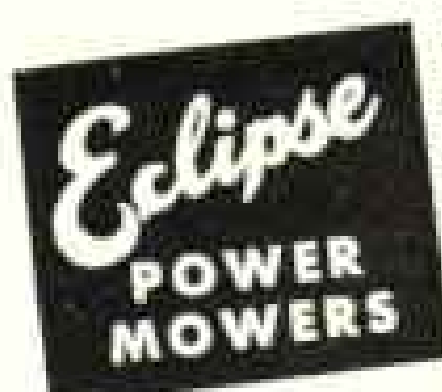


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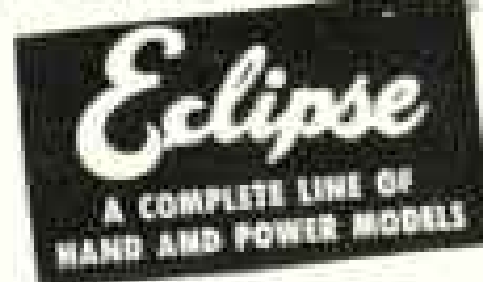
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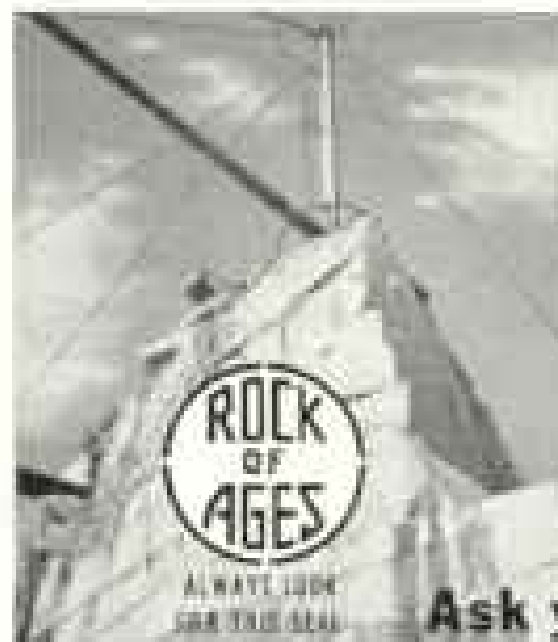
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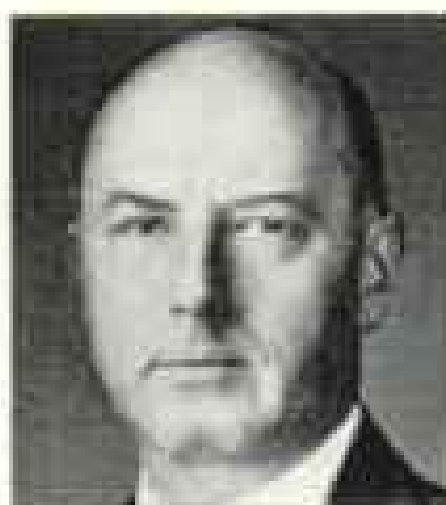
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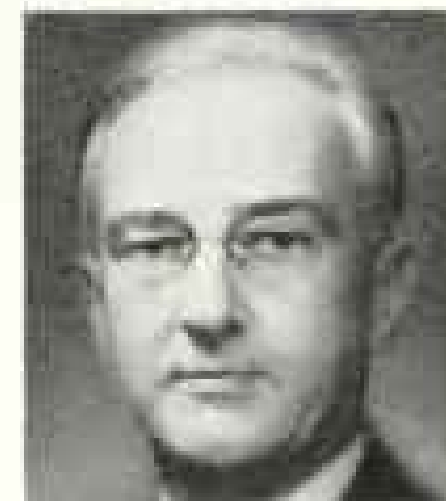


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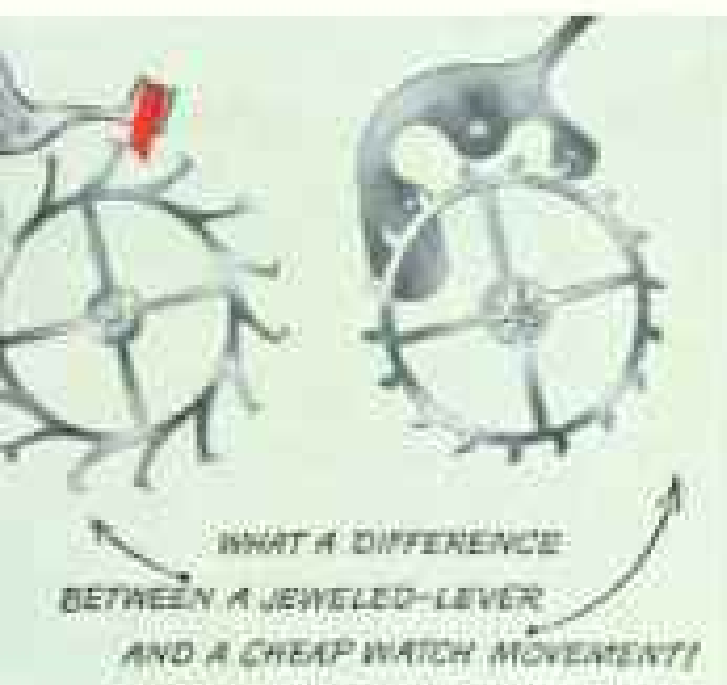
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